EXHIBIT 1

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Watanabe

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(54) **GOLF BALL**

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(58) **Field of Search** 473/251–377

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(57) **ABSTRACT**

A multi-piece golf ball includes a rubbery elastic core, a cover having a plurality of dimples on the surface thereof, and at least one intermediate layer between the core and the cover. The intermediate layer is composed of a resin material which is harder than the cover. The elastic core has a hardness which gradually increases radially outward from the center to the surface thereof. The center and surface of the elastic core have a hardness difference of at least 18 JIS-C hardness units. This construction and combination of features improve the distance of the ball when struck with a driver, provide the ball with excellent spin characteristics and thus good controllability on approach shots, and gives the ball a good feel on impact, enabling the ball to meet the high expectations of skilled golfers.

27 Claims, 1 Drawing Sheet

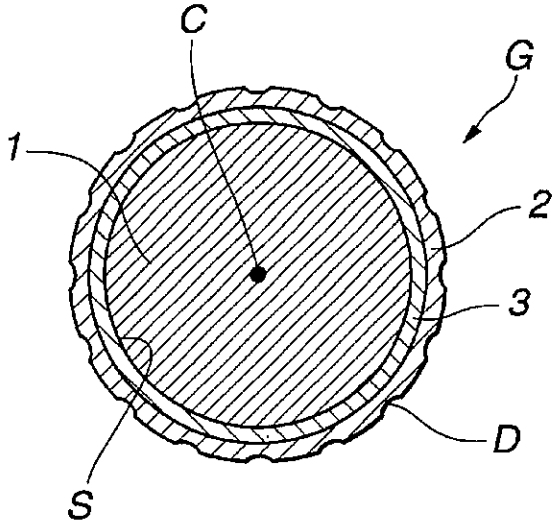
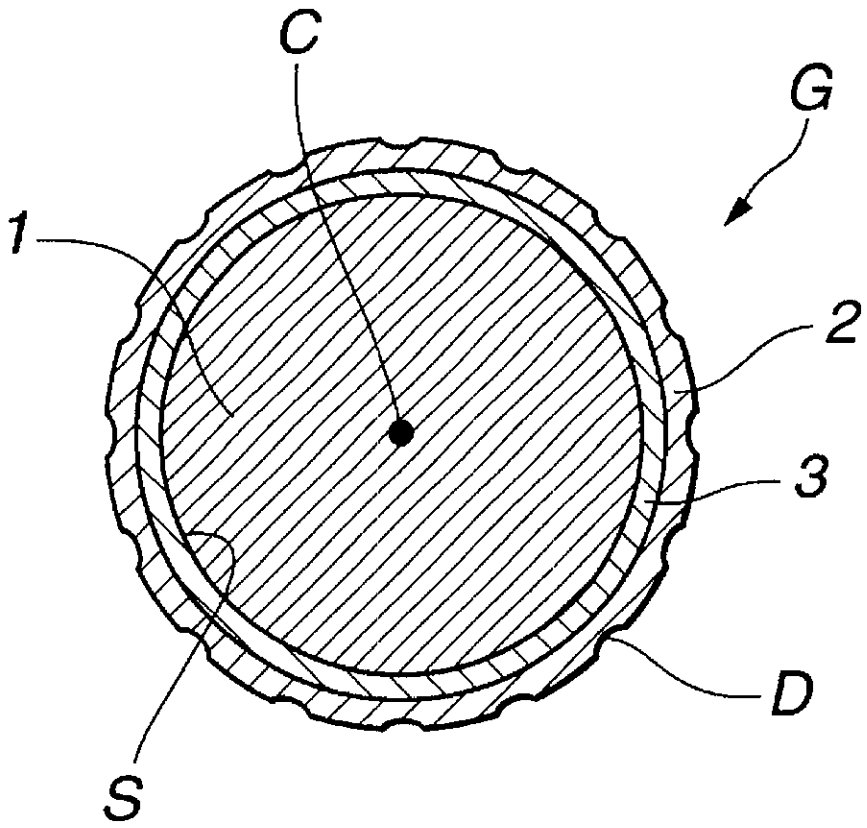


FIG.1



GOLF BALL

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a golf ball having a multilayer construction of at least three layers which includes a core, an intermediate layer and a cover. More particularly, the invention relates to a golf ball which has good rebound characteristics and provides an excellent travel distance, controllability and "feel" upon impact with a golf club.

2. Prior Art

In recent years, solid golf balls, with their good flight performance, have consistently won greater general approval than conventional thread-wound golf balls.

Solid golf ball constructions include two-piece balls made of a solid, high-resilience, rubber core enclosed within a relatively thin resin cover, and multi-piece balls having a core, a cover, and also an intermediate layer therebetween whose properties differ somewhat from those of the cover.

As already noted, because of their good flight performance (i.e., long travel distance), solid golf balls of these types are widely favored by both amateur and professional golfers. Yet, there remains a desire among golfers for even better flight performance.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a golf ball having a multilayer construction of three or more layers that is endowed with improved distance without diminishing the controllability and feel that are so important to skilled golfers.

Accordingly, the invention provides a golf ball comprising a rubbery elastic core having a center and a radially outer surface, a cover having a plurality of dimples on the surface thereof, and at least one intermediate layer situated between the core and the cover. The intermediate layer is composed of a resin material which is harder than the cover. The elastic core has a hardness which gradually increases radially outward from the center to the surface thereof, and a difference in JIS-C hardness of at least 18 between the center and the surface.

Preferably, the JIS-C hardness at the center of the core is 50 to 65, and the JIS-C hardness at the surface of the core is 70 to 90. The core typically undergoes a deformation of 3.0 to 5.0 mm when the load applied thereto is increased from an initial load of 98 N (10 kgf) to a final load of 1,275 N (130 kgf).

BRIEF DESCRIPTION OF THE DRAWING

The objects, features and advantages of the invention will become more apparent from the following detailed description, taken in conjunction with the accompanying diagram.

The only FIGURE, FIG. 1 is a sectional view showing a golf ball according to one embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIG. 1, the golf ball G of the present invention has a construction composed of at least three layers, commonly known as a "multi-piece construction," which include a rubbery elastic core 1, a cover 2 that is generally made of a resin material and has a plurality of dimples D on the surface thereof, and one or more intermediate layer 3 between the core 1 and the cover 2, all situated in a concentric fashion. The illustrated embodiment has a single intermediate layer. The intermediate layer 3 is made of a resin material which is harder than the cover 2. The core 1 having a center C and a surface S at its radially outer extremity has a JIS-C hardness which gradually increases radially outward from the center C to the surface S. The core 1 is formed so as to have a specific hardness difference between the surface S and the center C.

The inventive golf ball includes a hard intermediate layer disposed between the core, which has an optimized hardness profile, and the cover which is softer than the intermediate layer. This construction provides the ball with an excellent "feel," holds down spin when the ball is struck with a driver, and increases the distance traveled, in part by creating a trajectory which does not describe a high arc when traveling into a headwind. At the same time, it increases the amount of spin on approach shots taken with a club having a large loft angle, thus imparting the excellent control desired in particular by professionals and other skilled golfers.

In the golf ball of the present invention, the core may be made from a known core material which is prepared by blending, for example, a base rubber, the metal salt of an unsaturated carboxylic acid, and an organic peroxide.

The base rubber is preferably polybutadiene. The use of 1,4-polybutadiene, and especially one having a cis structure of at least 40%, is recommended. In addition to the polybutadiene, the base rubber may also include other rubbers such as natural rubber, polyisoprene rubber and styrene-butadiene rubber, if necessary.

Examples of suitable metal salts of unsaturated carboxylic acids include zinc dimethacrylate and zinc diacrylate. Zinc diacrylate is especially preferred for achieving a high rebound energy. It is advantageous to include such unsaturated carboxylic acids in an amount of at least 15 parts by weight, and preferably at least 20 parts by weight, but not more than 50 parts by weight, and preferably not more than 45 parts by weight, per 100 parts by weight of the base rubber.

Examples of suitable organic peroxides include 1,1-bis(t-butylperoxy)-3,3,5-trimethylcyclohexane, dicumyl peroxide, di-(t-butylperoxy)-m-diisopropylbenzene and 2,5-dimethyl-2,5-di-t-butylperoxyhexane. It is advantageous to include such peroxides in an amount of at least 0.1 part by weight, and preferably at least 0.5 part by weight, but not more than 5 parts by weight, and preferably not more than 2 parts by weight, per 100 parts by weight of the base rubber.

To impart good rebound characteristics, it is advisable to include a suitable compounding ingredient such as a thiophenol, thionaphthol, halogenated thiophenol or metal salt thereof in the core material. Specific examples of such compounding ingredients that may be used include pentachlorothiophenol, pentafluorothiophenol, pentabromothiophenol, p-chlorothiophenol and the zinc salt of pentachlorothiophenol. The zinc salt of pentachloro-thiophenol is especially preferred. Such a compounding ingredient is typically included in an amount of at least 0.4 part by weight, and preferably at least 0.6 part by weight, but not more than 2.0 parts by weight, and preferably not more than 1.2 parts by weight, per 100 parts by weight of the base rubber. Too much of this ingredient tends to lower the core hardness, which can adversely impact the feel of the ball when hit as well as its durability (cracking resistance), whereas too little may lower the rebound energy of the core, making it impossible for the ball to achieve a sufficient carry.

If necessary, the core material may include also various additives such as inorganic fillers and antioxidants. Illustrative examples of such additives include zinc oxide, barium sulfate and calcium carbonate.

The core may be fabricated from the above core material by using a conventional process to blend the various ingredients and mold the resulting mixture. For example, the constituent ingredients may be blended in a suitable apparatus such as a Banbury mixer or a kneader to form a "slug," which is then placed in a mold where it is vulcanized at a temperature of generally at least 150° C., and preferably at least 160° C., but generally not more than 190° C., and preferably not more than 180° C. The period of vulcanization is generally at least 8 minutes, and preferably at least 12 minutes, but generally not more than 20 minutes, and preferably not more than 16 minutes.

The weight and diameter of the core may be suitably adjusted according to such factors as the constituent materials and thickness of the intermediate layer and the cover, which are described subsequently. It is recommended that the core generally have a weight of at least 23 g, and preferably at least 30 g, but not more than 37 g, and preferably not more than 35 g. It is also recommended that the core generally have a diameter of at least 33 mm, and preferably at least 36 mm, but not more than 39 mm, and preferably not more than 38 mm.

It is critical for the core to have an optimized hardness profile in which the hardness gradually increases radially outward from the center toward the outside edge or surface of the core. That is, the core has a higher hardness at the surface than at the center.

The core center and surface must have a difference between their respective measured JIS-C hardnesses of at least 18, preferably at least 20, and most preferably at least 22 units. This difference in hardness within the core gives the ball a low spin when hit with a driver (number 1 wood), enabling it to travel well and thus attain a good total distance. Too small a difference in JIS-C hardness between the relatively soft center and the relatively hard surface of the core allows the ball to take on too much spin when hit with a driver, so that it does not travel well and has a short run after it lands on the ground. This makes it impossible to achieve the desired distance. It is recommended that the upper limit in the hardness difference be at most 30, preferably 27 or less, and most preferably 25 units or less.

Specifically, the core at the center typically has a JIS-C hardness of at least 50, and preferably at least 55, but not more than 65, and preferably not more than 62. The core at the surface typically has a JIS-C hardness of at least 70, and preferably at least 75, but not more than 90, and preferably not more than 85. Too low a JIS-C hardness at the core center may deaden the feel and fail to achieve the desired rebound energy, whereas a hardness that is too high may result in an excessively hard feel when the ball is hit. Similarly, too low a JIS-C hardness at the core surface may deaden the feel of the ball when hit, while too high a hardness may result in too hard a feel.

Preferably the core of the inventive golf ball has a deformation of at least 3.0 mm, and preferably at least 3.3 mm, but not more than 5.0 mm, and preferably not more than 4.5 mm, when the load applied thereto is increased from an initial load of 98 N (10 kgf) to a final load of 1,275 N (130 kgf). Too small a deformation may increase the spin when the ball is hit with a driver, preventing the desired travel from being achieved, and may also give the ball too hard a feel. On the other hand, too much deformation may deaden the feel and fail to achieve the necessary rebound energy.

Since the core has a hardness gradually increasing radially outward from the center to the surface thereof and an optimized difference in hardness between the center and the surface where the core is hardest, the inventive golf ball having the above-described core functions to suppress the generation of excessive spin when it is hit with a driver, effectively increasing the run after it lands on the ground, and thus travelling a longer total distance.

The intermediate layer 3 of the inventive golf ball is an essential layer which is situated between the core 1 and the cover 2 of the ball G, as shown in FIG. 1, and is made of a resin material that is harder than the cover material. Even if the core and cover are within the scope of the present invention, a golf ball lacking the adequate intermediate layer prescribed by the present invention fails to attained the objects of the invention since it cannot adequately suppress spin when hit with a driver, making it impossible to achieve a longer travel distance, and gives a poor feel when hit.

The intermediate layer may be made using a known cover material, illustrative examples of which include an ionomer resin, either by itself or in admixture with a polyester, polyurethane, polyamide, polyolefin or polystyrene thermoplastic elastomer. The use of an ionomer resin by itself is especially preferred, although another thermoplastic resin may be used provided the resin material for the intermediate layer has a greater hardness than the cover. As with the cover material described below, pigments and various other additives may be included in the intermediate material.

The intermediate layer can be formed over the surface of the core using a known process, preferably an injection molding process. For example, once the core is placed within a mold, the intermediate layer material is injection molded over the core in a conventional manner.

The intermediate layer must have a greater hardness than the cover, which is described below. If the intermediate layer has a hardness which is the same as or lower than that of the cover, spin is not adequately suppressed when the ball is hit with a driver, in addition to which the ball has a lower rebound energy, preventing the anticipated total distance from being achieved. It is generally advantageous for the intermediate layer and the cover to have a Shore D hardness difference of at least 2, and preferably at least 5 units, but not more than 20, and preferably not more than 15 units.

It is recommended that the intermediate layer itself have a Shore D hardness of generally at least 50, and preferably at least 55, but not more than 67, and preferably not more than 65.

As already noted, the intermediate layer situated between the core and the cover in the golf ball of the invention has a greater hardness than the cover. The hardnesses of the intermediate layer and the core, when compared using the same hardness scale (i.e., JIS-C hardness or Shore D hardness), are preferably such that the intermediate layer has a greater hardness than the surface of the core. The JIS-C hardness difference between the intermediate layer and the core surface is preferably at least 2, and more preferably at least 6 units, but not more than 22, and more preferably not more than 18 units.

It is recommended that the intermediate layer have a thickness which is generally at least 0.5 mm, but not more than 3 mm, and especially not more than 2 mm. In cases where there are two or more intermediate layers, it is advisable to set the overall thickness of the intermediate layers within the above range.

If the golf ball has two or more intermediate layers situated between the core and the cover, the above-described

hardness relationship must be maintained between the cover and the outer intermediate layer which is in close contact with the cover.

The cover of the golf ball is formed of a material which is softer than the intermediate layer material. Examples of suitable cover materials include ionomer resins and polyurethane thermoplastic elastomers which are softer than the intermediate layer material. The use of an ionomer resin is especially preferred.

It is advantageous for the cover to have a Shore D hardness of generally at least 45, and especially at least 48, but not more than 60, and especially not more than 58. A hardness value that is too low may result in increased spin and an inability to achieve the required total distance. On the other hand, a hardness value that is too high may adversely impact the controllability of shots taken with an iron club having a large loft angle, and approach shots.

A conventional process may be used to form the cover. It is especially preferable to use an injection molding process in which a solid core over which an intermediate layer has been formed is placed within a mold, and the cover material is injection molded over the intermediate layer.

It is recommended that the cover generally have a thickness of at least 0.6 mm, and preferably at least 1.0 mm, but not more than 2.1 mm, and preferably not more than 1.8 mm. Too thin a cover may lower the durability of the ball, whereas a cover that is too thick may lower the ball's rebound energy.

Since the golf ball of the invention has an optimized balance in hardness among the various layers as described above, the ball is endowed with an excellent rebound energy, distance performance, feel, controllability and spin characteristics.

For competition play, the golf ball of the invention may be formed so as to have a diameter and weight which conform with the Rules of Golf. That is, the ball may have a diameter of not less than 42.67 mm and a weight of not greater than 45.93 g.

The inventive golf ball provides increased distance when hit with a driver. On approach shots, the ball has excellent spin characteristics to ensure control as desired. Moreover, it has a good feel on impact. This combination of qualities enables the ball to satisfy the high expectations of skilled golfers in particular.

EXAMPLES

Examples of the invention and comparative examples are given below by way of illustration, and are not intended to limit the invention.

Examples 1-3 and Comparative Examples 1-5

To ascertain the flight characteristics and feel of golf balls according to one embodiment of the invention, golf balls with different hardnesses at the center and surface of the core were produced in Examples 1, 2 and 3. A number of additional examples were carried out for the purpose of comparison. The golf balls produced in Comparative Example 1 had cores with a small or flat hardness profile. The balls produced in Comparative Example 2 had cores with a noticeable, yet gradual, hardness profile. The balls produced in Comparative Example 3 had a core with a distinct hardness profile, but had an intermediate layer that was softer than the cover. The balls produced in Comparative Examples 4 and 5 similarly had cores with distinct hardness profiles, but lacked an intermediate layer. Comparative tests were conducted on these various balls.

The balls were all given the same arrangement of dimples on the surface of the cover. Namely, each ball had a total of 432 dimples of three types formed on the cover in an icosahedral arrangement.

Tables 1 and 2 below show the characteristics of the cover and intermediate layer in the ball samples in each example. Table 3 gives the characteristics of the core in the same balls, and Table 4 presents the test results obtained for each type of ball.

TABLE 1

		Example			Comparative Example				
		1	2	3	1	2	3	4	5
Cover	Material	a	a	a	a	a	b	a	a
	Thickness (mm)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
	Hardness (Shore D)	55	55	55	55	55	65	55	55
Inter-	Material	b	b	b	b	b	a	—	—
mediate	Thickness (mm)	1.5	1.5	1.5	1.5	1.5	1.5	—	—
layer	Hardness (Shore D)	65	65	65	65	65	55	—	—

TABLE 2

Cover, intermediate layer		a	b
Composition (parts by weight)	Himilan AM7317 (Zn)[1]		50
	Himilan 1650 (Zn)[2]	50	
	Himilan AM7318 (Na)[3]		50
	Surlyn 8120 (Na)[4]	50	
	Titanium oxide	5	5
Hardness	Shore D hardness	55	65
	JIS-C hardness	80	94

[1]A zinc ionomer resin having an acid content of 18% made by DuPont-Mitsui Polychemicals Co., Ltd.
[2]A zinc ionomer resin made by DuPont-Mitsui Polychemicals Co., Ltd.
[3]A sodium ionomer resin having an acid content of 18% made by DuPont-Mitsui Polychemicals Co., Ltd.
[4]A sodium ionomer resin made by E. I. DuPont de Nemours and Co.

TABLE 3

			Example			Comparative Example				
			1	2	3	1	2	3	4	5
Core	Compo-	1,4-cis-Polybutadiene	100	100	100	100	100	100	100	100
	sition	Zinc diacrylate	41.0	38.0	35.0	28.0	27.8	38.0	32.1	28.4
	(pbw)	Peroxide (1)[1]	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
		Peroxide (2)[2]	0.8	0.8	0.8	0.6	0.6	0.8	0.8	0.8
		Sulfur[3]	0.1	0.1	0.1	0	0	0.1	0.1	0.1
		Antioxidant[4]	0	0	0	0.2	0.2	0	0	0
		Barium sulfate	24.1	25.2	26.4	29.8	29.9	25.2	12.8	14.4
		Zinc oxide	5	5	5	5	5	5	5	5

TABLE 3-continued

			Example			Comparative Example				
			1	2	3	1	2	3	4	5
	Zinc salt of pentachlorothiophenol		1	1	1	0.2	0.2	1	1	1
Vulcanization conditions	Primary	Temperature (° C.)	175	175	175	140	155	175	175	175
		Time (min)	15	15	15	30	15	15	15	15
	Secondary	Temperature (° C.)	—	—	—	165	—	—	—	—
		Time (min)	—	—	—	15	—	—	—	—
Hardness	Surface (JIS-C hardness)		85	83	78	76	76	83	87	80
	Center (JIS-C hardness)		61	59	55	72	60	59	63	56
	JIS-C hardness difference		24	24	23	4	16	24	24	24
Deformation under loading (mm)[5]			3.4	3.8	4.1	3.3	3.4	3.8	3.4	4.1

[1]Dicumyl peroxide, produced by NOF Corporation under the trade name Percumyl D.
[2]1,1-Bis(t-butylperoxy)-3,3,5-trimethylcyclohexane, produced by NOF Corporation under the trade name Perhexa 3M-40.
[3]Zinc white-containing sulfur, produced by Tsurumi Chemical Industry Co., Ltd.
[4]Nocrack NS-6, produced by Ouchi Shinko Chemical Industrial Co., Ltd.
[5]Deformation under loading from an initial load of 98 N to a final load of 1,275 N.

TABLE 4

		Example			Comparative Example				
		1	2	3	1	2	3	4	5
Flight[1]	Carry (m)	233.0	232.2	231.1	233.2	232.1	232.5	231.8	229.5
	Total distance (m)	241.2	243.8	244.9	238.5	239.9	245.5	238.3	241.1
	Spin (rpm)	2805	2745	2700	2910	2855	2550	2952	2847
	Rating	good	good	good	poor	poor	good	poor	fair
Approach[2]	Spin (rpm)	5833	5821	5811	5849	5830	4100	5870	5832
	Rating	good	good	good	good	good	poor	good	good
Feel[3]	When hit with driver	good	good	good	good	good	good	good	poor
	When hit with putter	good	good	good	good	good	poor	good	good

[1]Flight was rated as follows, based on distance measured when ball was hit at a head speed of 50 m/s by a driver mounted on a swing robot.
Good: Total distance at least 241 m
Fair: Total distance at least 241 m, but carry less than 230 m
Poor: Total distance 240 m or less.
[2]Approach was rated as follows, based on spin rate measured when ball was hit at a head speed of 19 m/s by a sand wedge mounted on a swing robot.
Good: Good spin (at least 5,500 rpm)
Poor: Inadequate spin (less than 4,500 rpm)
[3]Average sensory evaluations for five professional golfers:
Good: Feel was appropriate and good.
Poor: Feel was too hard or too soft.

As is apparent from the results in Table 4, the golf balls according to the invention all showed a good balance of distance, controllability on approach shots, and feel.

By contrast, the golf balls produced in the comparative examples each had drawbacks. In Comparative Examples 1 and 2, the hardness difference between the surface and center of the core was less than 18, resulting in much spin and a poor distance when the ball was hit with a driver. In Comparative Example 3, the cover was harder than the intermediate layer, and had an excessively high hardness. As a result, the amount of spin on approach shots was low and controllability was poor. In addition, the feel when hit with a putter was poor. The golf balls produced in Comparative Example 4 were two-piece balls which lacked between the cover and the core an intermediate layer of greater hardness than the cover. These balls had a lot of spin when hit with a driver, and thus a poor distance. In the golf balls produced in Comparative Example 5, the core hardness was lowered to reduce the high spin rate on impact with a driver in Comparative Example 4, but the resulting feel on impact with a driver was too soft.

Japanese Patent Application No. 2000-190640 is incorporated herein by reference.

Although some preferred embodiments have been described, many modifications and variations may be made thereto in light of the above teachings. It is therefore to be understood that the invention may be practiced otherwise than as specifically described without departing from the scope of the appended claims.

What is claimed is:

1. A golf ball comprising a rubbery elastic core having a center and a radially outer surface, a cover having a plurality of dimples on the surface thereof, and at least one intermediate layer situated between the core and the cover; wherein

said intermediate layer is composed of a resin material which is harder than the cover and has a greater hardness than the surface of the elastic core when compared using the same hardness scale, and

said elastic core has a hardness which gradually increases radially outward from the center to the surface thereof, and a difference in JIS-C hardness of at least 22 between the center and the surface.

2. The golf ball of claim 1, wherein said core at the center has a JIS-C hardness of 50 to 65, and at the surface a JIS-C hardness of 70 to 90.

3. The golf ball of claim 1, wherein said core undergoes a deformation of 3.0 to 5.0 mm when the load applied

thereto is increased from an initial load of 98 N (10 kgf) to a final load of 1,275 N (130 kgf).

4. The golf ball of claim 1, wherein the difference in JIS-C hardness between the center of the elastic core and the surface thereof is 22 to 30 units.

5. The golf ball of claim 1, wherein the intermediate layer has a Shore D hardness of 50 to 67.

6. The golf ball of claim 1, wherein the JIS-C hardness difference between said intermediate layer and said core surface is 2 to 22 units.

7. The golf ball of claim 1, wherein the cover has a Shore D hardness of 45 to 60.

8. The golf ball of claim 1, wherein the golf ball has two or more intermediate layers situated between the core and the cover, and said hardness relationship is maintained between the cover and the outer intermediate layer which is in close contact with the cover.

9. The golf ball of claim 1, wherein the core is formed of rubber as a base and the cover is formed of materials including ionomer resins and polyurethane thermoplastic elastomers.

10. The golf ball of claim 1, wherein said elastic core is formed of rubber as the base material comprising an ingredient selected from a group consisting of thiophenol, thionaphthol, halogenated thiophenol and metal salt thereof.

11. The golf ball of claim 1, wherein said elastic core is formed of rubber as the base material comprising an ingredient selected from a group consisting of pentachlorothiophenol, pentafluorothiophenol, pentabromothiophenol, p-chlorothiophenol and the zinc salt of pentachlorothiophenol.

12. The golf ball of claim 1, wherein said elastic core is formed of rubber as the base material comprising an ingredient of zinc salt of pentachlorothiophenol added in an amount of 0.4 to 2.0 parts by weight, to per 100 parts by weight of the base rubber.

13. A golf ball comprising a rubbery elastic core having a center and a radially outer surface, a cover having a plurality of dimples on the surface thereof, and at least one intermediate layer situated between the core and the cover; wherein

said intermediate layer is composed of a resin material which is harder than the cover, and has a greater hardness than the surface of the elastic core when compared using the same JIS-C hardness scale, and

said elastic core has a hardness at the center and a hardness at the surface thereof which is greater than the hardness at the center thereof, and a difference in JIS-C hardness of at least 22 between the center and the surface.

14. The golf ball of claim 13, wherein said core at the center has a JIS-C hardness of 50 to 65, and at the surface a JIS-C hardness of 70 to 90.

15. The golf ball of claim 13, wherein the difference in JIS-C hardness between the center of the elastic core and the surface thereof is 22 to 30 units.

16. The golf ball of claim 13, wherein the intermediate layer has a Shore D hardness of 50 to 67.

17. The golf ball of claim 12, wherein the JIS-C hardness difference between said intermediate layer and said core surface is 2 to 22 units.

18. The golf ball of claim 12, wherein the cover has a Shore D hardness of 45 to 60.

19. The golf ball of claim 12, wherein the golf ball has two or more intermediate layers situated between the core and the cover, and said hardness relationship is maintained between the cover and the outer intermediate layer which is in close contact with the cover.

20. The golf ball of claim 12, wherein the core is formed of rubber as a base and the cover is formed of materials including ionomer resins and polyurethane thermoplastic elastomers.

21. The golf ball of claim 13, wherein said elastic core is formed of rubber as the base material comprising an ingredient selected from a group consisting of thiophenol, thionaphthol, halogenated thiophenol and metal salt thereof.

22. The golf ball of claim 13, wherein said elastic core is formed of rubber as the base material comprising an ingredient selected from a group consisting of pentachlorothiophenol, pentafluorothiophenol, pentabromothiophenol, p-chlorothiophenol and the zinc salt of pentafluorothiophenol.

23. The golf ball of claim 13, wherein said elastic core is formed of rubber as the base material comprising an ingredient of zinc salt of pentachlorothiophenol added in an amount of 0.4 to 2.0 parts by weight, to per 100 parts by weight of the base rubber.

24. A golf ball comprising a rubbery elastic core having a center and a radially outer surface, a cover having a plurality of dimples on the surface thereof, and at least one intermediate layer situated between the core and the cover; wherein

said intermediate layer is composed of a resin material which is harder than the cover having a Shore D hardness of 45 to 58 and has a greater hardness than the surface of the elastic core when compared using the same hardness scale, and

said elastic core has a hardness at the center and a hardness at the surface thereof which is greater than the hardness at the center thereof, and a difference in JIS-C hardness of at least 22 between the center and the surface.

25. The golf ball of claim 24, wherein said elastic core is formed of rubber as the base material comprising an ingredient selected from a group consisting of thiophenol, thionaphthol, halogenated thiophenol and metal salt thereof.

26. The golf ball of claim 24, wherein said elastic core is formed of rubber as the base material comprising an ingredient selected from a group consisting of pentachlorothiophenol, pentafluorothiophenol, pentabromothiophenol, p-chlorothiophenol and the zinc salt of pentachlorothiophenol.

27. The golf ball of claim 24, wherein said elastic core is formed of rubber as the base material comprising an ingredient of zinc salt of pentachlorothiophenol added in an amount of 0.4 to 2.0 parts by weight, to per 100 parts by weight of the base rubber.

* * * * *

EXHIBIT 2

J1052 U.S. PTO
09/880844
06/15/01

ISSUE CLASSIFICATION	Class	Subclass
	473	371

PATENT NUMBER
6679791
6679791

U.S. UTILITY Patent Application

O.I.P.E.
SCANNED LH3 Q.A.

PATENT DATE
JAN 20 2004

APPLICATION NO.	CONT/PRIOR	CLASS	SUBCLASS	ART UNIT	EXAMINER
09/880844		473	371	3711	HUNTER

APPLICANTS: Hideo Watanabe

TITLE: Golf Ball

PTO-2040 12/98

ISSUING CLASSIFICATION

ORIGINAL CLASS	ORIGINAL SUBCLASS	CROSS REFERENCE(S) CLASS	CROSS REFERENCE(S) SUBCLASS (ONE SUBCLASS PER BLOCK)
473	371	473	351

INTERNATIONAL CLASSIFICATION
A63B 37/04
A63B 37/06
A63B 37/00

☐ Continued on Issue Slip Inside File Jacket

12/7/03 Formal Drawings (1 sht(s)) rec'd 6/15/01

☑ TERMINAL DISCLAIMER	DRAWINGS Sheets Drwg.	Figs. Drwg.	Print Fig.	CLAIMS ALLOWED Total Claims	Print Claim for O.G.
	1	1	1	27	1

☐ The term of this patent subsequent to _____ (date) has been disclaimed.

☑ The term of this patent shall not extend beyond the expiration date of U.S Patent No. Pending

☐ The terminal ____ months of this patent have been disclaimed.

ALLEN R. HUNTER, JR. (Assistant Examiner) 9/25/03 (Date)

Paul T. Sewell
Supervisory Patent Examiner
Group 3700
(Primary Examiner) 9/25/03 (Date)

(Legal Instruments Examiner) (Date)

NOTICE OF ALLOWANCE MAILED
9/26/03

ISSUE FEE
Amount Due: $1300.00
Date Paid: 11-26-03
ISSUE BATCH NUMBER

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The information disclosed herein may be restricted. Unauthorized disclosure may be prohibited by the United States Code Title 35, Sections 122, 181 and 368. Possession outside the U.S. Patent & Trademark Office is restricted to authorized employees and contractors only.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/880,844	06/15/2001	Hideo Watanabe	Q64962	6597

7590 05/17/2002

SUGHRUE, MION, ZINN, MACPEAK & SEAS, PLLC
2100 Pennsylvania Avenue, N.W.
Washington, DC 20037-3213

EXAMINER
HUNTER, ALVIN A

ART UNIT	PAPER NUMBER
3711	

DATE MAILED: 05/17/2002

#4

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 07-01)

Office Action Summary	Application No.	Applicant(s)
	09/880,844	WATANABE, HIDEO
	Examiner	Art Unit
	Alvin A. Hunter	3711

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *15 June 2001* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-3* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-3* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *3* .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

U.S. Patent and Trademark Office
PTO-326 (Rev. 04-01) Office Action Summary Part of Paper No. 4

DETAILED ACTION

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1 and 2 are rejected under 35 U.S.C. 103(a) as being unpatentable over Moriyama et al. (USPN 6336872) and OFFICIAL NOTICE.

Moriyama et al. discloses a golf ball having excellent flight performance and hitting feel (See Abstract). The golf ball comprises a center, intermediate layer, and an outer layer covering (See Abstract). The center comprises natural rubber and has a hardness of 65 to 85 JIS-C and a surface hardness higher than the center by no more than 10 and notes if the difference between the surface hardness and center are more than 10 then the rebound characteristics and shot feel are affected (See Column 2, lines 15 through 32; and Column 3, lines 15 through 39), in which is shown having a difference as high as15 in Comparative Example 2 in Table 7. Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have the surface higher than the center by any value, such as at least 18, in order to obtain the desired rebounding and feel characteristic for the golf ball through routine optimization. The intermediate layer is preferably made of an ionomer resin and has a hardness of 60 to 85 JIS-C (See Column 4, lines 49 through 56). The cover has a hardness 15 to 40 higher than the intermediate layer and notes that if the hardness

difference is smaller than 15 that the shot feel will be affected (See Column 5, lines 20 through 37). Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have any difference in intermediate layer and outer layer, such as the intermediate layer hardness being higher than the cover hardness, in order to obtain the desired shot feel for the golf ball through routine optimization. OFFICIAL NOTICE is taken that majority of golf ball have dimples thereon the surface of the cover to improve the aerodynamic properties of the ball. It would have been obvious to one having ordinary skill in the art at the time the invention was made to place dimples on the outer surface of the cover, as taught by the OFFICIAL NOTICE, in order to improve the aerodynamic properties of the golf ball.

Double Patenting

The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. See *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970);and, *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent is shown to be commonly owned with this application. See 37 CFR 1.130(b).

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

Claims 1-3 are provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1, 2 and 4 of copending Application No. 09/811,119. Although the conflicting claims are not identical,

they are not patentably distinct from each other because Application No. 09/811,119 discloses the same subject matter except for the intermediate layer being softer than the cover. Clearly to make the cover harder than the intermediate layer would change the feel and rebounding characteristics of the golf ball. To make the above change would be nothing more than an optimization process. It would have been obvious to one having ordinary skill in the art at the time the invention was made to have an intermediate layer softer than the cover in order to obtain the feel and rebounding characteristics desired for the user and designer through routine optimization.

This is a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Alvin A. Hunter whose telephone number is 703-306-5693. The examiner can normally be reached on Monday through Friday from 7:30AM to 4:00PM Eastern Time.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Paul Sewell, can be reached on (703) 308-2126. The fax phone number for the organization where this application or proceeding is assigned is 703-308-7768.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-1148.

Paul T. Sewell
Supervisory Patent Examiner
Group 3700

Notice of References Cited	Application/Control No. 09/880,844	Applicant(s)/Patent Under Reexamination WATANABE, HIDEO	
	Examiner Alvin A. Hunter	Art Unit 3711	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
	A	US-5,002,281	03-1991	Nakahara et al.	473/373
	B	US-5,072,944	12-1991	Nakahara et al.	473/373
	C	US-5,830,085	11-1998	Higuchi et al.	473/373
	D	US-6,190,269	02-2001	Moriyama, Keiji	473/373
	E	US-6,287,218	09-2001	Ohama, Keiji	473/377
	F	US-6,315,682	11-2001	Iwami et al.	473/370
	G	US-6,319,155	11-2001	Moriyama et al.	473/371
	H	US-6,336,872	01-2002	Moriyama et al.	473/374
	I	US-6,354,967	03-2002	Nakamura et al.	473/377
	J	US-6,358,159	03-2002	Yamagishi et al.	473/374
	K	US-6,379,268	04-2002	Yamagishi et al.	473/371
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

3711

PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

RKent 8/20/02 #5/a

In re application of

Hideo WATANABE

Docket No: Q64962

Appln. No.: 09/880,844

Group Art Unit: 3711

Confirmation No.: 6597

Examiner: Alvin A. HUNTER

Filed: June 15, 2001

For: GOLF BALL

AMENDMENT UNDER 37 C.F.R. § 1.111

Commissioner for Patents
Washington, D.C. 20231

Sir:

In response to the Office Action dated May 17, 2002, please amend the above-identified application as follows:

IN THE CLAIMS:

Please add the following new claims 4-20:

4. (New) The golf ball of claim 1, wherein the difference in JIS-C hardness between the center of the elastic core and the surface thereof is 18 to 30 units.

5. (New) The golf ball of claim 1, wherein the intermediate layer has a Shore D hardness of 50 to 67.

6. (New) The golf ball of claim 1, wherein the intermediate layer has a greater hardness than the surface of the elastic core when compared using the same hardness scale.

7. (New) The golf ball of claim 6, wherein the JIS-C hardness difference is 2 to 22 units.

8. (New) The golf ball of claim 1, wherein the cover has a Shore D hardness of 45 to 60.

9. (New) The golf ball of claim 1, wherein the golf ball has two or more intermediate layers situated between the core and the cover, and said hardness relationship is maintained between the cover and the outer intermediate layer which is in close contact with the cover.

10. (New) The golf ball of claim 1, wherein the core is formed of rubber as a base and the cover is formed of materials including ionomer resins and polyurethane thermoplastic elastomers.

11. (New) A golf ball comprising a rubbery elastic core having a center and a radially outer surface, a cover having a plurality of dimples on the surface thereof, and at least one intermediate layer situated between the core and the cover, wherein

said intermediate layer is composed of a resin material which is harder than the cover, and

said elastic core has a hardness at the center and a hardness at the surface thereof which is greater than the hardness at the center thereof, and a difference in JIS-C hardness of at least 18 between the center and the surface, and undergoes a deformation of 3.0 to 5.0 mm when the load applied thereto is increased from an initial load of 98 N (10 kgf) to a final load of 1,275 N (130 kgf).

12. (New) A golf ball comprising a rubbery elastic core having a center and a radially outer surface, a cover having a plurality of dimples on the surface thereof, and at least one intermediate layer situated between the core and the cover, wherein

said intermediate layer is composed of a resin material which is harder than the cover, and

said elastic core has a hardness at the center and a hardness at the surface thereof which is greater than the hardness at the center thereof, and a difference in JIS-C hardness of at least 18 between the center and the surface.

13. (New) The golf ball of claim 12, wherein said core at the center has a JIS-C hardness of 50 to 65, and at the surface a JIS-C hardness of 70 to 90.

14. (New) The golf ball of claim 12, wherein the difference in DIS-C hardness between the center of the elastic core and the surface thereof is 18 to 30 units.

15. (New) The golf ball of claim 12, wherein the Intermediate .layer has a Shore D hardness of 50 to 67.

16. (New) The golf ball of claim 12, wherein the intermediate layer has a greater hardness than the surface of the elastic core when compared using the same JIS-C hardness scale.

17. (New) The golf ball of claim 16, wherein the JIS-C hardness difference is 2 to 22 units.

18. (New) The golf ball of claim 12, wherein the cover has a Shore D hardness of 45 to 60.

19. (New) The golf ball of claim 12, wherein the golf ball has two or more intermediate layers situated between the core and the cover, and said hardness relationship is maintained between the cover and the outer intermediate layer which is in close contact with the cover.

20. (New) The golf ball of claim 12, wherein the core is formed of rubber as a base and the cover is formed of materials including ionomer resins and polyurethane thermoplastic elastomers.

A1 (cont.)

REMARKS

Claims 1-20 are all the claims now pending in the application.

I. Claim Rejections under 35 U.S.C. § 103

Claims 1 and 2 stand rejected under 35 U.S.C. § 103(a) as obvious over Moriyama et al. (U.S. Patent No. 6,336,872) and OFFICIAL NOTICE. Applicant traverses these rejections for at least the reasons discussed below.

To establish a prima facie case of obviousness the Examiner must show that the prior art references, when combined, teach or suggest all of the claim limitations. See MPEP § 2143. Applicant respectfully submits that the references cited above by the Examiner fail to teach or suggest all of the claim limitations as set forth in the present application. Specifically, Moriyama fails to teach 1) an intermediate layer which is harder than the cover, and 2) a difference in JIS-C hardness of at least 18 between the center and the surface.

In rejecting claims 1 and 2, the Examiner relies on Moriyama to teach all of the claim limitations except for dimples in the cover. For that, the Examiner takes OFFICIAL NOTICE that golf balls generally have dimples in the cover. Moriyama relates to a multi-piece solid golf ball. The golf ball of Moriyama comprises a center having at least one layer, an intermediate layer formed on the center, and an outer layer covering the intermediate layer. As acknowledged by the Examiner the surface hardness of the center is higher than the central point hardness of the center by not more than 10. Claims 1 and 2 require a difference of at least 18. The Examiner attempts to reconcile this by stating comparative example 2 shows differences as high as 15 and "[t]herefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have the surface higher than the center by any value, such as at least 18,

in order to obtain the desired rebounding and feel characteristic for the golf ball through routine optimization." Applicant submits that Moriyama teaches away from a difference of at least 18 when stating that the core difference must not be more than 10. One skilled in the art, based on this teaching, would not be motivated to increase the hardness difference to "at least 18," because Moriyama specifically teaches not to increase the difference above 10. Thus, the Examiner's unsupported conclusion is without merit.

Furthermore, the Comparative Example 2 shown in Table 7 does not satisfy the difference of "at least 18" in JIS-C hardness described above. In addition, according to the Comparative Example 2 of Table 7, the hardness of the intermediate layer is 62 and the hardness of the outer layer (cover) is 99 on JIS-C scale, which is the opposite relationship of hardness recited in claims 1 and 2.

Additionally, the Examiner acknowledges that the JIS-C hardness of the outer layer is higher than the hardness of the intermediate layer by 15 to 40. In other words, the intermediate layer of Moriyama is softer than the cover, which is the complete opposite relationship than that recited in claims 1 and 2. Once again, the Examiner attempts to cure the deficient teachings of Moriyama using only a broad conclusory statement that it would have been obvious to reverse the hardness relationship taught by Moriyama "in order to obtain the desired shot feel for the golf ball through routine optimization." However, broad conclusory statements regarding the teaching of references, alone, are not evidence. *Ecolochem, Inc. v. Southern Cal. Edison Co.*, 227 F.3d 1361, 1372 (Fed. Cir. 2000) (Emphasis added). Furthermore, the Examiner cannot simply ignore the teachings of the reference in order to meet the limitations of the claims. Such is impermissible hindsight. The mere fact that a reference can be modified does not make the

resultant modification obvious unless the prior art also suggests the desirability of the modifications. See *In re Mills*, 916 F.2d 680, 16 USPQ2d 1430 (Fed. Cir. 1990). Here, Moriyama not only fails to teach the claimed hardness relationship, it actually teaches the desirability of the opposite hardness relationship. Said differently, Moriyama actually teaches that it is desirable to have the cover be harder than the intermediate layer by at least 15-40 degrees. Moreover, the Examiner is silent with respect to where in Moriyama the desirability to have the intermediate layer harder than the cover is taught. The Examiner is silent in this respect because Moriyama does not teach that the intermediate layer can be or should be harder than the cover, and instead, Moriyama teaches just the opposite (that the cover should be harder than the intermediate layer by 15-40 degrees). Therefore, since the Examiner has not provided any evidence that teaches or suggests the desirability to modify the Moriyama reference to have an intermediate layer that is harder than the cover, Applicant submits that the Examiner has failed to establish a *prima facie* case of obviousness.

In view of the above remarks, Applicant respectfully requests that the rejections of claims 1 and 2 under 35 U.S.C. § 103(a) be reconsidered and withdrawn.

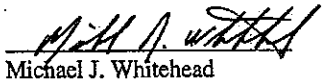
II. Double Patenting Rejections

Claims 1-3 stand provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1, 2 and 4 of co-pending Application No. 09/811,119. Claim 1 (and claims 2 and 4 by virtue of their dependency from claim 1) of co-pending Application No. 09/811,119 has recently been amended, and therefore, Applicant submits that double patenting rejection is now moot.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,



SUGHRUE MION, PLLC
2100 Pennsylvania Avenue, N.W.
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Telephone: (202) 293-7060
Facsimile: (202) 293-7860

Michael J. Whitehead
Registration No. 48,071

Date: August 15, 2002

APPENDIX

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS:

Claims 4-20 are added as new claims.

S.M.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/880,844	06/15/2001	Hideo Watanabe	Q64962	6597

7590 10/29/2002

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Washington, DC 20037-3213

EXAMINER	
HUNTER, ALVIN A	
ART UNIT	PAPER NUMBER
3711	

DATE MAILED: 10/29/2002 #6

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 07-01)

5B

Office Action Summary	Application No.	Applicant(s)	
	09/880,844	WATANABE, HIDEO	
	Examiner	Art Unit	
	Alvin A. Hunter	3711	

-- *The MAILING DATE of this communication appears on the cover sheet with the correspondence address* --

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- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *15 August 2002* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-20* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-20* is/are rejected.

7)☒ Claim(s) *14 and 15* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *3* .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

U.S. Patent and Trademark Office
PTO-326 (Rev. 04-01) **Office Action Summary** Part of Paper No. 6

DETAILED ACTION

Claim Objections

1. Claims 14 and 15 are objected to because of the following informalities: In claim 14, "DIS-C" should read –JIS-C- and in claim 15, "Intermediate. Layer" should read – intermediate layer--. Appropriate correction is required.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 1, 2, 4-8, 10-18, and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Moriyama et al. (USPN 6336872) in view of Nakamura et al. (USPN 5803833) and Farrally et al. (Science and Golf III).

Moriyama et al. discloses a golf ball having excellent flight performance and hitting feel comprises a center, intermediate layer, and an outer layer covering (See Abstract). The center comprises natural rubber and has a hardness of 65 to 85 JIS-C and a surface hardness higher than the center by no more than 10 and notes if the difference between the surface hardness and center are more than 10 then the rebound characteristics and shot feel are affected (See Column 2, lines 15 through 32; and Column 3, lines 15 through 39). The intermediate layer and outer layer can be made of the same materials such as ionomer resin with combinations of other materials in which polyurethane elastomer consists within the group (See Column 3, lines 50 through 59)

and Column 5, lines 1 through 9). The outer layer has a hardness 15 to 40 higher than the intermediate layer, preferably no less than 90 JIS-C or Shore D 60, and notes that if the hardness difference is smaller than 15 that the shot feel will be affected (See Column 5, lines 20 through 37). Moriyama et al. also notes that the golf ball may comprise dimples (See Column 5, lines 43 through 53). Moriyama et al. does not teach having an intermediate layer harder than the cover and having a hardness distribution of the core gradually increase from the center to the surface. Nakamura et al. discloses a two piece golf, in which improved feeling is obtained by providing a core with a hardness distribution with the hardness gradually decreasing from the core's surface to the core's center (See Background of the invention and the Detailed Description). The core has a Shore D hardness distribution and deformation that is equivalent to the JIS-C hardness and deformation ranges of that claimed by the applicant. Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have the surface higher than the center by at least 15 and a core deformation of 3 to mm, as taught by Nakamura et al., in order to obtain the desired feel characteristic for the golf ball through routine optimization. Farrally et al. teaches that the advantage of having a mantle layer harder than the cover if to give a golf ball increased resilience as well as hardness (See Alternate Multi-Layer Constructions on page 413). Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have any difference in hardness of an intermediate layer harder than outer layer, as taught by Farrally et al., in order to increase the resilience and hardness of the golf ball.

Double Patenting

The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. See *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970);and, *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent is shown to be commonly owned with this application. See 37 CFR 1.130(b).

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

3. Claims 1-20 are provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-9 of copending Application No. 09/881,119 in view of Farrally et al. (Science and Golf III). Although the conflicting claims are not identical, they are not patentably distinct from each other because Application No. 09/881,119 discloses the same subject matter except for the intermediate layer being softer than the cover. Farrally et al. teaches that having a mantle harder than the cover shows increased resilience with hardness; therefore, implying that if a decrease in resilience is desired that the mantle should be softer than the cover (See Alternate Multi-Layer Constructions). It would have been obvious to one having ordinary skill in the art at the time the invention was made to have an intermediate layer softer than the cover in order to obtain resilience desired for the user and designer through routine optimization.

This is a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

Response to Arguments

Applicant's arguments with respect to claims 1-3 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Alvin A. Hunter whose telephone number is 703-306-5693. The examiner can normally be reached on Monday through Friday from 7:30AM to 4:00PM Eastern Time.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Paul Sewell, can be reached on (703) 308-2126. The fax phone number for the organization where this application or proceeding is assigned is 703-308-7768.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-1148.

[illegible]
[illegible]
[illegible]

Notice of References Cited	Application/Control No. 09/880,844	Applicant(s)/Patent Under Reexamination WATANABE, HIDEO	
	Examiner Alvin A. Hunter	Art Unit 3711	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
	A	US-5,803,833	09-1998	Nakamura et al.	473/377
	B	US-			
	C	US-			
	D	US-			
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	Farrally, M.R. et al., Science and Golf III: Proceedings of the 1998 World Scientific Congress of Golf", Illinois: Human Kinetics, copyright 1999, p. 413.
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

U.S. Patent and Trademark Office
PTO-892 (Rev. 01-2001) **Notice of References Cited** Part of Paper No. 6

PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of

Hideo WATANABE

Docket No: Q64962

Appln. No.: 09/880,844

Group Art Unit: 3711

Confirmation No.: 6597

Examiner: Alvin A. HUNTER

Filed: June 15, 2001

For: GOLF BALL

AMENDMENT UNDER 37 C.F.R. § 1.111

Commissioner for Patents
Washington, D.C. 20231

Sir:

In response to the Office Action dated October 29, 2002, please amend the above-identified application as follows:

IN THE CLAIMS:

Please cancel claims 6, 11 and 16 without prejudice or disclaimer.

Please enter the following amended claims:

1. (Amended) A golf ball comprising a rubbery elastic core having a center and a radially outer surface, a cover having a plurality of dimples on the surface thereof, and at least one intermediate layer situated between the core and the cover; wherein

said intermediate layer is composed of a resin material which is harder than the cover and has a greater hardness than the surface of the elastic core when compared using the same hardness scale, and

said elastic core has a hardness which gradually increases radially outward from the center to the surface thereof, and a difference in JIS-C hardness of at least 18 between the center and the surface.

12. (Amended) A golf ball comprising a rubbery elastic core having a center and a radially outer surface, a cover having a plurality of dimples on the surface thereof, and at least one intermediate layer situated between the core and the cover; wherein

said intermediate layer is composed of a resin material which is harder than the cover, and has a greater hardness than the surface of the elastic core when compared using the same JIS-C hardness scale, and

said elastic core has a hardness at the center and a hardness at the surface thereof which is greater than the hardness at the center thereof, and a difference in JIS-C hardness of at least 18 between the center and the surface.

14. (Amended) The golf ball of claim 12, wherein the difference in JIS-C hardness between the center of the elastic core and the surface thereof is 18 to 30 units.

15. (Amended) The golf ball of claim 12, wherein the intermediate layer has a Shore D hardness of 50 to 67.

Please add the following new claims:

21. (New) A golf ball comprising a rubbery elastic core having a center and a radially outer surface, a cover having a plurality of dimples on the surface thereof, and at least one intermediate layer situated between the core and the cover; wherein

said intermediate layer is composed of a resin material which is harder than the cover having a Shore D hardness of 45 to 58 and has a greater hardness than the surface of the elastic core when compared using the same hardness scale, and

said elastic core has a hardness at the center and a hardness at the surface thereof which is greater than the hardness at the center thereof, and a difference in JIS-C hardness of at least 18 between the center and the surface.

REMARKS

Claims 1-5, 7-11, 12-15, 17-21 are all the claims now pending in the application. Claims 6, 11 and 16 have been canceled and claim 21 has been added as a new claim.

I. Claim Objections

Claims 14 and 15 stand objected to for each containing a typographical informality. Applicant has amended the claims and corrected the informalities as suggested by the Examiner. The scope of the claims has not been narrowed. Therefore, Applicant respectfully requests that the objection to claims 14 and 15 be reconsidered and withdrawn.

II. Claim Rejections under 35 U.S.C. § 103

Claims 1, 2, 4-5, 7-8, 10-18 and 20 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Moriyama et al. (U.S. Patent No. 6,336,872) in view of Nakamura et al. (U.S. Patent No. 5,803,833) and Farrally et al. (Science and Golf III). To establish a *prima facie* case of obviousness the Examiner must show that the prior art references, when combined, teach or suggest all of the claim limitations. See MPEP § 2143. Applicant respectfully submits that the references cited above by the Examiner fail to teach or suggest all of the claim limitations as set forth in the present application.

A. References do not teach an intermediate layer which is harder than the cover.

Moriyama fails to teach an intermediate layer which is harder than the cover. In fact, Moriyama teaches the opposite relationship, namely, an intermediate layer that is softer than the

cover. Specifically, Moriyama discloses that "[i]n the golf ball of the present invention, it is required that a JIS-C hardness of the outer layer 3 is higher than the hardness of the intermediate layer 2 by 15 to 40, preferably 19 to 37". Moriyama col. 5:20-23. Nakamura fails to cure this deficiency because the golf ball disclosed in the Nakamura reference is a two-piece solid golf ball, and thus, the golf ball of Nakamura does not have an intermediate layer. Consequently, Nakamura cannot teach an intermediate layer that is harder than the cover. Finally, Farrally discloses that a hard inner layer (or mantle) material should show increased resilience with hardness, such as ionomers or crosslinked polybutadiene, and a soft mantle material should be one that shows increased resilience as the material becomes softer, such as metallocenes like "Exact" or "Engage", polyester elastomers such as "Hytrel", or polyester amides such as "Pebax." However, Farrally merely discloses the relationship between resilience and hardness in the general materials of golf balls, which does not teach or suggest that the intermediate layer is harder than the cover as claimed. The Examiner uses Farrally to teach that it is simply a matter of design choice to have the intermediate layer be harder than the outer cover layer depending on the Applicant's desired results. While Farrally teaches the relationship between resilience and hardness in the general materials of golf balls, it fails to teach when or why one would have found it obvious, in view of the teachings of Moriyama, to modify the hardness of the intermediate layer to be harder than the outer cover layer.

Accordingly, none of the cited references teaches or suggests the claimed relationship of an intermediate layer being harder than the cover.

B. References do not teach an intermediate layer having a greater hardness than the surface of the core.

Moriyama fails to teach or suggest an intermediate layer having a greater hardness than the surface of the elastic core. Once again, Moriyama teaches the complete opposite relationship. Specifically, Moriyama teaches that "the JIS-C hardness of the intermediate layer is lower than the surface hardness of the center by 0 to 10." Moriyama col. 2:8-10 (emphasis added). Again, Nakamura fails to cure this deficiency because the golf ball disclosed in the Nakamura reference is a two-piece solid golf ball, and thus, the golf ball of Nakamura does not have an intermediate layer. Consequently, Nakamura cannot teach an intermediate layer that is harder than the surface of the core. Finally, as discussed above, Farrally does not teach or suggest any hardness relationship between the intermediate layer and the surface of the core. Accordingly, none of the cited references teaches or suggests the claimed relationship of an intermediate layer being harder than the surface of the core.

C. References do not teach an elastic core having a difference in JIS-C hardness of at least 18 between the core center and the core surface.

Moriyama fails to teach or suggest a difference in JIS-C hardness of at least 18 between the core center and the core surface. Moriyama teaches that the difference in JIS-C hardness between the core center and core surface is less than 10. Moriyama col. 2:6-8; col. 3:23-26. Moriyama explains that the reason why the difference threrebetween is less than 10 is that when the hardness difference is larger than 10, "the rebound characteristics are not sufficiently obtained and the shot feel is heavy and poor." Id. col. 3:27-30. On the other hand, the present

specification describes at least one reason why the elastic core has a difference in JIS-C hardness of at least 18 between the center and the surface:

> The difference in hardness within the core gives the ball a low spin when hit with a driver (number 1 wood), enabling it to travel well and thus attain a good total distance. Too small a difference in JIS-C hardness between the relatively soft center and the relatively hard surface of the core allows the ball to take on too much spin when hit with a driver, so that it does not travel well and has a short run after it lands on the ground. This makes it impossible to achieve the desired distance.

Specification page 5, lines 22-33.

Thus, since neither Nakamura nor Farrally cure the deficient teachings of Moriyama, Applicant submits that the references, either alone or in combination, do not disclose and suggest the difference of the claimed hardness and the effects thereof.

D. References fail to teach a core which gradually increases radially outward from the center to the surface thereof.

Applicant submits that the combination of these references fails to teach a core which "gradually increases radially outward from the center to the surface thereof." The Examiner acknowledges on page 3 of the office action that Moriyama fails to teach this feature, but then contends that Nakamura teaches this gradually increasing hardness of the core. However, Nakamura teaches that from 4 mm from the core's surface to 2 mm from the core 's surface, the hardness actually decreases. Nakamura col. 2:54-64; Abstract. Therefore, the core of Nakamura fails to gradually increase from the core center to the core surface. Accordingly, the cited references fail to teach or suggest this limitation.

In view of the above remarks, Applicant submits that the references fail to teach or suggest all of claimed limitations. Therefore, Applicant respectfully requests that the rejection of claims 1, 2, 4-5, 7-8, 10-18 and 20 under 35 U.S.C. § 103(a) be reconsidered and withdrawn.

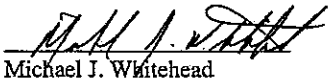
III. Double Patenting

Claims 1-20 are provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-9 of copending Application No. 09/881,119 in view of Farrally et al. (Science and Golf III). Applicant submits herewith a terminal disclaimer which disclaims the terminal part of any patent issuing from the present application. However, the submission of the terminal disclaimer is not intended as an admission that the claims of the patent application applied by the Examiner are substantively sufficient to support the Examiner's rejection. Therefore, Applicant respectfully requests that the double patenting rejection be reconsidered and withdrawn.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,



Michael J. Whitehead
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Facsimile: (202) 293-7860

Date: January 29, 2003

AMENDMENT UNDER 37 C.F.R. § 1.111 **Attorney Docket No.: Q64962**
Appln. No.: 09/880,844

APPENDIX

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS:

Claims 6, 11 and 16 are canceled.

The claims are amended as follows:

1. (Amended) A golf ball comprising a rubbery elastic core having a center and a radially outer surface, a cover having a plurality of dimples on the surface thereof, and at least one intermediate layer situated between the core and the cover; wherein

said intermediate layer is composed of a resin material which is harder than the cover and has a greater hardness than the surface of the elastic core when compared using the same hardness scale, and

said elastic core has a hardness which gradually increases radially outward from the center to the surface thereof, and ~~is harder at the surface of the elastic core than said intermediate layer and a difference in JIS-C hardness between the center at the elastic core and the surface thereof is 21 to 30 and undergoes a deformation of 3.5 to 6.0 mm when the load applied thereto is increased from an initial load of 98 n (10 kgf) to a final load of 1,275 N (130 kgf)~~a difference in JIS-C hardness of at least 18 between the center and the surface.

12. (Amended) A golf ball comprising a rubbery elastic core having a center and a radially outer surface, a cover having a plurality of dimples on the surface thereof, and at least one intermediate layer situated between the core and the cover; wherein

said intermediate layer is composed of a resin material which is harder than the cover, and has a greater hardness than the surface of the elastic core when compared using the same JIS-C hardness scale, and

said elastic core has a hardness at the center and a hardness at the surface thereof which is greater than the hardness at the center thereof, and a difference in JIS-C hardness of at least 18 between the center and the surface.

14. (Amended) The golf ball of claim 12, wherein the difference in ~~DIS-C~~JIS-C hardness between the center of the elastic core and the surface thereof is 18 to 30 units.

15. (Amended) The golf ball of claim 12, wherein the ~~Intermediate layer~~intermediate layer has a Shore D hardness of 50 to 67.

New claim 21 is added.

CM

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/880,844	06/15/2001	Hideo Watanabe	Q64962	6597

7590 04/14/2003

SUGHRUE, MION, ZINN, MACPEAK & SEAS, PLLC
2100 Pennsylvania Avenue, N.W.
Washington, DC 20037-3213

EXAMINER
HUNTER, ALVIN A

ART UNIT	PAPER NUMBER
3711	10

DATE MAILED: 04/14/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 07-01)

Office Action Summary	Application No.	Applicant(s)	
	09/880,844	WATANABE, HIDEO	
	Examiner	Art Unit	
	Alvin A. Hunter	3711	

-- *The MAILING DATE of this communication appears on the cover sheet with the correspondence address* --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (5) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *29 January 2003* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-5,7-10,12-15 and 17-21* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-5,7,8,10,12-15,17,18,20 and 21* is/are rejected.

7)☒ Claim(s) *9 and 19* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 3 .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

U.S. Patent and Trademark Office
PTO-326 (Rev. 04-01) **Office Action Summary** Part of Paper No. 10

DETAILED ACTION

Terminal Disclaimer

The terminal disclaimer filed on January 01, 2003 disclaiming the terminal portion of any patent granted on this application which would extend beyond the expiration date of Application No. 09/881,119 has been reviewed and is accepted. The terminal disclaimer has been recorded.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 7 and 17 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 7 and 17 depend from claim in which were cancelled. For examination purposes, claims 7 and 17 will be treated as depending from claims 1 and 12.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-5, 7, 8, 10, 12-15, and 17, 18, 20, and 21 are rejected under 35 U.S.C. 102(b) as being anticipated by Yamagishi et al. (USPN 5782707).

Yamagishi et al. discloses a three-piece golf ball having a core, intermediate layer, and a cover with a plurality of dimples (See Abstract and Figure 1). The core comprises a polybutadiene based rubber and has a center hardness of up to 75 JIS-C, equivalent of up to 49 Shore D, and surface hardness of up to 85 JIS-C, equivalent of up to 56 Shore D (See Column 3, lines 17 through 25). The core also has a surface to center hardness difference in JIS-C of 8 to 20, wherein Yamagishi et al. prefers the hardness to gradually decrease from the surface to the center (See Column 3, lines 30 through 51). The intermediate layer comprises ionomer resins and has a JIS-C hardness of 75 to 100, equivalent of 49 to 68 Shore D, wherein the intermediate layer is higher than the core's surface hardness by at least 5 JIS-C units (See Column 4, lines 39 through 67). The cover may comprises an admixture of ionomer resin and polyurethane and has a JIS-C hardness of up to 90 JIS-C, equivalent of 60 Shore D, wherein it is noted that the cover is softer than the intermediate layer by at least 5 degrees (See Column 5, lines 1 through 34).

Allowable Subject Matter

Claims 9 and 19 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Response to Arguments

Applicant's arguments with respect to claims 1-20 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Alvin A. Hunter whose telephone number is 703-306-5693. The examiner can normally be reached on Monday through Friday from 7:30AM to 4:00PM Eastern Time.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Paul Sewell, can be reached on (703) 308-2126. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9302.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-1148.

Paul T. Sewell
Supervisory Patent Examiner
Group 3700

Notice of References Cited	Application/Control No. 09/880,844	Applicant(s)/Patent Under Reexamination WATANABE, HIDEO	
	Examiner Alvin A. Hunter	Art Unit 3711	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
	A	US-5,782,707	07-1998	Yamagishi et al.	473/374
	B	US-			
	C	US-			
	D	US-			
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Amdt
#11/C

In re application of

Hideo WATANABE

Docket No: Q64962

Appln. No.: 09/880,844

Group Art Unit: 3711

7/22/03
BRoss

Confirmation No.: 6597

Examiner: Alvin A. HUNTER

Filed: June 15, 2001

For: GOLF BALL

AMENDMENT UNDER 37 C.F.R. § 1.111

Commissioner for Patents
Washington, D.C. 20231

Sir:

In response to the Office Action dated April 14, 2003, please amend the above-identified application as follows on the accompanying pages and as allowed by the new format specified in the Official Gazette Notice of February 25, 2003, entitled, *Amendments in a Revised Format Now Permitted*, wherein the requirements of 37 C.F.R. § 1.121 (a-d) have been waived.:

07/23/2003 SZIMMERM 00000001 194888 09880844

01 FC:1202 108.00 DA

IN THE CLAIMS:

Please enter the following amended claims:

1. (Currently Amended) A golf ball comprising a rubbery elastic core having a center and a radially outer surface, a cover having a plurality of dimples on the surface thereof, and at least one intermediate layer situated between the core and the cover; wherein

said intermediate layer is composed of a resin material which is harder than the cover and has a greater hardness than the surface of the elastic core when compared using the same hardness scale, and

said elastic core has a hardness which gradually increases radially outward from the center to the surface thereof, and a difference in JIS-C hardness of at least ~~18~~ 22 between the center and the surface.

2. (Original) The golf ball of claim 1, wherein said core at the center has a JIS-C hardness of 50 to 65, and at the surface a JIS-C hardness of 70 to 90.

3. (Original) The golf ball of claim 1, wherein said core undergoes a deformation of 3.0 to 5.0 mm when the load applied thereto is increased from an initial load of 98 N (10 kgf) to a final load of 1,275 N (130 kgf).

4. (Currently Amended) The golf ball of claim 1, wherein the difference in JIS-C hardness between the center of the elastic core and the surface thereof is ~~18~~ 22 to 30 units.

5. (Previously Added) The golf ball of claim 1, wherein the intermediate layer has a Shore D hardness of 50 to 67.

6. (Canceled)

7. (Currently Amended) The golf ball of claim 61, wherein the JIS-C hardness difference between said intermediate layer and said core surface is 2 to 22 units.

8. (Previously Presented) The golf ball of claim 1, wherein the cover has a Shore D hardness of 45 to 60.

9. (Previously Presented) The golf ball of claim 1, wherein the golf ball has two or more intermediate layers situated between the core and the cover, and said hardness relationship is maintained between the cover and the outer intermediate layer which is in close contact with the cover.

10. (Previously Presented) The golf ball of claim 1, wherein the core is formed of rubber as a base and the cover is formed of materials including ionomer resins and polyurethane thermoplastic elastomers.

11. (Canceled)

12. (Currently Amended) A golf ball comprising a rubbery elastic core having a center and a radially outer surface, a cover having a plurality of dimples on the surface thereof, and at least one intermediate layer situated between the core and the cover; wherein

said intermediate layer is composed of a resin material which is harder than the cover, and has a greater hardness than the surface of the elastic core when compared using the same JIS-C hardness scale, and

said elastic core has a hardness at the center and a hardness at the surface thereof which is greater than the hardness at the center thereof, and a difference in JIS-C hardness of at least ~~18~~ 22 between the center and the surface.

~~13~~. (Previously Presented) The golf ball of claim ~~12~~, wherein said core at the center has a JIS-C hardness of 50 to 65, and at the surface a JIS-C hardness of 70 to 90.

~~14~~. (Currently Amended) The golf ball of claim ~~12~~, wherein the difference in JIS-C hardness between the center of the elastic core and the surface thereof is ~~18~~ 22 to 30 units.

~~15~~. (Previously Presented) The golf ball of claim ~~12~~, wherein the intermediate layer has a Shore D hardness of 50 to 67.

16. (Canceled)

~~17~~. (Currently Amended) The golf ball of claim ~~16~~12, wherein the JIS-C hardness difference between said intermediate layer and said core surface is 2 to 22 units.

18. (Previously Presented) The golf ball of claim 12, wherein the cover has a Shore D hardness of 45 to 60.

19. (Previously Presented) The golf ball of claim 12, wherein the golf ball has two or more intermediate layers situated between the core and the cover, and said hardness relationship is maintained between the cover and the outer intermediate layer which is in close contact with the cover.

20. (Previously Presented) The golf ball of claim 12, wherein the core is formed of rubber as a base and the cover is formed of materials including ionomer resins and polyurethane thermoplastic elastomers.

21. (Currently Amended) A golf ball comprising a rubbery elastic core having a center and a radially outer surface, a cover having a plurality of dimples on the surface thereof, and at least one intermediate layer situated between the core and the cover; wherein

said intermediate layer is composed of a resin material which is harder than the cover having a Shore D hardness of 45 to 58 and has a greater hardness than the surface of the elastic core when compared using the same hardness scale, and

said elastic core has a hardness at the center and a hardness at the surface thereof which is greater than the hardness at the center thereof, and a difference in JIS-C hardness of at least ~~18~~ 22 between the center and the surface.

22. (New) The golf ball of claim 1, wherein said elastic core is formed of rubber as the base material comprising an ingredient selected from a group consisting of thiophenol, thionaphthol, halogenated thiophenol and metal salt thereof.

23. (New) The golf ball of claim 1, wherein said elastic core is formed of rubber as the base material comprising an ingredient selected from a group consisting of pentachlorothiophenol, pentafluorothiophenol, pentabromothiophenol, p-chlorothiophenol and the zinc salt of pentachlorothiophenol.

24. (New) The golf ball of claim 1, wherein said elastic core is formed of rubber as the base material comprising an ingredient of zinc salt of pentachlorothiophenol added in an amount of 0.4 to 2.0 parts by weight, to per 100 parts by weight of the base rubber.

25. (New) The golf ball of claim 12, wherein said elastic core is formed of rubber as the base material comprising an ingredient selected from a group consisting of thiophenol, thionaphthol, halogenated thiophenol and metal salt thereof.

26. (New) The golf ball of claim 12, wherein said elastic core is formed of rubber as the base material comprising an ingredient selected from a group consisting of pentachlorothiophenol, pentafluorothiophenol, pentabromothiophenol, p-chlorothiophenol and the zinc salt of pentafluorothiophenol.

27. (New) The golf ball of claim 12, wherein said elastic core is formed of rubber as the base material comprising an ingredient of zinc salt of pentachlorothiophenol added in an amount of 0.4 to 2.0 parts by weight, to per 100 parts by weight of the base rubber.

28. (New) The golf ball of claim 21, wherein said elastic core is formed of rubber as the base material comprising an ingredient selected from a group consisting of thiophenol, thionaphthol, halogenated thiophenol and metal salt thereof.

29. (New) The golf ball of claim 21, wherein said elastic core is formed of rubber as the base material comprising an ingredient selected from a group consisting of pentachiorothiophenol, pentafluorothiophenol, pentabromothiophenol, p-chlorothiophenol and the zinc salt of pentachlorothiophenol.

AMENDMENT UNDER 37 C.F.R. § 1.111 **Attorney Docket No.: Q64962**
Appln. No.: 09/880,844

Cont C1

~~30.~~ 27. (New) The golf ball of claim ~~21~~ 24, wherein said elastic core is formed of rubber as the base material comprising an ingredient of zinc salt of pentachlorothiophenol added in an amount of 0.4 to 2.0 parts by weight, to per 100 parts by weight of the base rubber.

C

REMARKS

Claims 1-5, 7-10, 12-15 and 17-30 are all the claims now pending in the application. Claims 22-30 have been added as new claims

I. Claim Rejections under 35 U.S.C. § 112

Claims 7 and 17 stand rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Specifically, claims 7 and 17 presently depend from claims 6 and 16 that were previously canceled. The subject matter of claims 6 and 16 was incorporated into independent claims 1 and 12 respectively. However, the dependency of claims 7 and 17 was inadvertently not amended to depend from amended claims 1 and 12. Applicant has amended herein claims 7 and 17 to correct this informality. Accordingly, Applicant respectfully requests that the rejection of claims 7 and 17 under 35 U.S.C. § 112 be reconsidered and withdrawn.

II. Claim Rejections under 35 U.S.C. § 102

Claims 1-5, 7, 8, 10, 12-15, 17, 18, 20 and 21 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Yamagishi et al. (U.S. Patent No. 5,782,707).

To be an "anticipation" rejection under 35 U.S.C. § 102, the reference must teach every element and limitation of the Applicant's claims. Rejections under 35 U.S.C. § 102 are proper only when the claimed subject matter is identically disclosed or described in the prior art. Thus the reference must clearly and unequivocally disclose every element and limitation of the claimed invention.

Regarding independent claims 1, 12 and 21, Applicant submits that Yamagishi fails to teach a core hardness difference of "at least 22". Yamagishi teaches a core hardness difference (i.e. a difference between hardness of core surface and core center in JIS-C) of 8-20, and thus is outside the claimed range of at least 22. Therefore, the Yamagishi reference does not anticipate claims 1, 12 and 21.

Additionally, Yamagishi explicitly teaches that if the core hardness difference is greater than 20, the core would "fail to provide sufficient restitution." *See Yamagishi col. 3:34-36.* Therefore, it would not be obvious to one skilled in the art to modify the core hardness of Yamagishi to have a core hardness difference of at least 22 because Yamagishi explicitly teaches away from such a modification.

In view of the above remark, Applicant submits that the Yamagishi reference fails to teach all of the limitations of independent claims 1, 12 and 21. Accordingly, Applicant respectfully requests that the rejection of independent claims 1, 12 and 21 under 35 U.S.C. § 102 be reconsidered and withdrawn.

Since claims 2-5, 7-10, 13-15, 17-20 and 22-30 depend from independent claims 1, 12 and 21, and since the Yamagishi reference does not disclose all of the limitations of independent claims 1, 12 and 21, Applicant submits that claims 2-5, 7-10, 13-15, 17-20 and 22-30 are patentable at least by virtue of their dependency from independent claims 1, 12 and 21. Accordingly, Applicant respectfully requests that the rejections of claims 2-5, 7-10, 13-15, 17-20 and 22-30 under 35 U.S.C. § 102 be reconsidered and withdrawn.

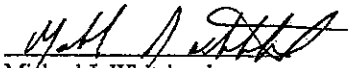
III. Allowable Subject Matter

The Examiner has indicated that claims 9 and 19 contain allowable subject matter and would be allowed if rewritten in independent form including all of the limitations of the base claim and any intervening claims. Applicant requests that the Examiner hold rewriting claims 9 and 19 in abeyance until the rejection of the parent claims has been reconsidered.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,



Michael J. Whitehead
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23373
PATENT TRADEMARK OFFICE

Date: July 11, 2003

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NOTICE OF ALLOWANCE AND FEE(S) DUE

7590 09/26/2003

SUGHRUE, MION, ZINN, MACPEAK & SEAS, PLLC
2100 Pennsylvania Avenue, N.W.
Washington, DC 20037-3213

EXAMINER	
HUNTER, ALVIN A	
ART UNIT	CLASS-SUBCLASS
3711	473-371000

DATE MAILED: 09/26/2003

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/880,844	06/15/2001	Hideo Watanabe	Q64962	6597

TITLE OF INVENTION: GOLF BALL

APPLN. TYPE	SMALL ENTITY	ISSUE FEE	PUBLICATION FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	$1300	$300	$1600	12/26/2003

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE REFLECTS A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE APPLIED IN THIS APPLICATION. THE PTOL-85B (OR AN EQUIVALENT) MUST BE RETURNED WITHIN THIS PERIOD EVEN IF NO FEE IS DUE OR THE APPLICATION WILL BE REGARDED AS ABANDONED.

HOW TO REPLY TO THIS NOTICE:

I. Review the SMALL ENTITY status shown above.

If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:
A. If the status is the same, pay the TOTAL FEE(S) DUE shown above.

B. If the status is changed, pay the PUBLICATION FEE (if required) and twice the amount of the ISSUE FEE shown above and notify the United States Patent and Trademark Office of the change in status, or

If the SMALL ENTITY is shown as NO:

A. Pay TOTAL FEE(S) DUE shown above, or

B. If applicant claimed SMALL ENTITY status before, or is now claiming SMALL ENTITY status, check the box below and enclose the PUBLICATION FEE and 1/2 the ISSUE FEE shown above.

☐ Applicant claims SMALL ENTITY status. See 37 CFR 1.27.

II. PART B - FEE(S) TRANSMITTAL should be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). Even if the fee(s) have already been paid, Part B - Fee(s) Transmittal should be completed and returned. If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PTOL-85 (Rev. 08/03) Approved for use through 04/30/2004.

AK

Notice of Allowability	Application No.	Applicant(s)	
	09/880,844	WATANABE, HIDEO	
	Examiner	Art Unit	
	Alvin A. Hunter	3711	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *07/11/2003*.
2. ☒ The allowed claim(s) is/are *1-5,7-10,12-15 and 17-30*.
3. ☒ The drawings filed on *15 June 2001* are accepted by the Examiner.
4. ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
   a) ☒ All b) ☐ Some* c) ☐ None of the:
      1. ☒ Certified copies of the priority documents have been received.
      2. ☐ Certified copies of the priority documents have been received in Application No. _____.
      3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.
5. ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
   (a) ☐ The translation of the foreign language provisional application has been received.
6. ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application. **THIS THREE-MONTH PERIOD IS NOT EXTENDABLE**

7. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.

8. ☐ CORRECTED DRAWINGS must be submitted.
   (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
      1) ☐ hereto or 2) ☐ to Paper No. ____.
   (b) ☐ including changes required by the proposed drawing correction filed _____, which has been approved by the Examiner.
   (c) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No. _____.

Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet.

9. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1☐ Notice of References Cited (PTO-892)
2☐ Notice of Informal Patent Application (PTO-152)
3☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
4☐ Interview Summary (PTO-413), Paper No.____.
5☒ Information Disclosure Statements (PTO-1449), Paper No. 3.
6☐ Examiner's Amendment/Comment
7☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
8☐ Examiner's Statement of Reasons for Allowance
9☐ Other

Paul T. Sewell
Supervisory Patent Examiner
Group 3700

U.S. Patent and Trademark Office
PTOL-37 (Rev. 04-03) **Notice of Allowability** Part of Paper No. 12

EXHIBIT 3

UNITED STATES DISTRICT COURT
DISTRICT OF DELAWARE

BRIDGESTONE SPORTS CO., LTD., and BRIDGESTONE GOLF, INC., Plaintiffs, v. ACUSHNET COMPANY, Defendant.	Case No. 05-CA-132 (JJF) **INVALIDITY EXPERT REPORT OF DR. DAVID FELKER**
ACUSHNET COMPANY, Counterclaimant, v. BRIDGESTONE SPORTS CO., LTD., and BRIDGESTONE GOLF, INC., Counterdefendant.	

(where the ball distortion is slightly less than the core distortion). Through an understanding of the basic physics of ball construction and/or knowledge of the Precept EV Extra Spin golf ball, one of ordinary skill in the art of golf ball manufacturing would appreciate that the ratio of core distortion divided by ball distortion should be between 1.0 and 1.3, as they did for the similar-constructions used by the Precept EV Extra Spin golf ball and in the GB '628 publication.

2. The Claimed Range of Shore D Hardness Would Have Been Obvious To One Of Ordinary Skill In The Art

As further shown by Bridgestone's own Precept EV Extra Spin golf ball, it would have been obvious to use a cover with a Shore D hardness of up to 60 with a soft core construction. The soft core is designed to improve feel; a cover with a Shore D hardness of up to 60 contributes to the feel, whereas a harder cover would detract from it. This fact was recognized in the Precept EV Extra Spin, which used a cover with a Shore D hardness of 52.

VII. THE '707, '834, AND '791 PATENTS

A. Overview of the Patents

I will now address three related Bridgestone patents: U.S. Patent No. 5,782,707 (the '707 Patent) (Ex. 25), U.S. Patent No. 5,803,834 (the '834 Patent) (Ex. 26) and U.S. Patent No. 6,6791,791 (the '791 Patent) (Ex. 27). These three patents claim golf balls having a core with a surface harder than the center, where the hardness of the core increases radially outward from the center, sometimes increasing by a specific amount. This feature is referred to in the art as a hardness gradient in the core. In particular, a core's "hardness gradient" is a measurement of how the hardness of the core's rubber changes from the center of the core to its surface.

1. The '707 Patent

The '707 patent, entitled a "Three-Piece Solid Golf Ball," was applied for at the PTO on March 10, 1997, claiming priority to Japanese patent application no. 8-082121, filed March 11, 1996. The PTO issued the '707 Patent to Bridgestone on July 21, 1998, naming as the inventors Hisashi Yamagishi and Hiroshi Higuchi. The claims of the '707 are directed to the following

combination of three elements: (1) a core with a particular hardness distribution, whose key feature is a hardness gradient of 8-20 degrees, (2) a three-piece structure with a hard intermediate layer between the core and soft cover, and (3) dimple coverage of at least 62%.

2. The '834 Patent

The '834 patent, entitled a "Two-Piece Golf Ball," was applied for at the PTO on February 27, 1997, claiming priority to Japanese patent application no. 8-071135, filed March 1, 1996 . On September 8, 1998, the PTO issued the '834 Patent to Bridgestone. The patent names Hisashi Yamagishi and Jun Shindo as the inventors. This patent generally claims the combination of: (1) a core with a particular hardness profile, whose key features are a hardness gradient of 8-20, and a relatively consistent hardness within the outer 5mm of the core, (2) a two piece structure with a hardness difference between the core and the cover, and a specified cover thickness and, (3) 360 – 450 dimples in the cover.

3. The '791 Patent

On January 20, 2004, over five and a half years after Bridgestone's '707 Patent issued, the PTO issued the '791 Patent, entitled "Golf Ball," to Bridgestone. The only named inventor of the '791 Patent is Hideo Watanabe. The '791 Patent, which like the '707 Patent discloses a three-piece solid golf ball, has claims directed toward the following combination of three elements: (1) a core with a hardness profile which is gradually increasing and a gradient of at least 22 degrees, (2) a three-or-more-piece structure whose key feature is that at least one intermediate layer is harder than the cover and the core, and (3) the use of a compounding agent such as zinc pentachlorothiophenol in the core formulation.

The '791 patent was filed in the PTO on June 15, 2001 and claimed priority to Japanese patent application No. 2000-1960640, filed June 26, 2000.

The original United States application for the '791 Patent claimed a core hardness gradient of "at least 18 degrees," and it only claimed cores with a "gradually increasing" hardness. The core gradient claim was rejected three times by the PTO. In the third office

action, the examiner rejected most of the '791's claims citing Bridgestone's '707 patent as anticipating the '791 claims. In particular, the examiner observed that the '707 patent taught a core with a hardness gradient of 8 to 20. The applicant then amended the claims in response to this office action and replaced the claim of a core gradient of at least 18 with a claim of a gradient of at least 22. The applicant argued to the PTO that, because the '707 patent did not show core gradients over 22, it did not anticipate the amended claim. In response to this, the examiner granted the claims of the '791 patent.

B. Overview of the Technology

1. Hardness Gradients in Rubber Chemistry

I have reviewed the expert report of Dr. Koenig, and I agree with him that formation of hardness gradients in cured rubbers is well-known in rubber chemistry. Scientists and engineers working on rubber molding have known about hardness gradients for decades. Much effort has gone into measuring and modeling the extent of cure in a molded rubber part. Also, academics have written papers on the modeling of the extent of cure in molded rubber parts.[6]

2. Hardness Gradients in the Golf Ball Art

Hardness gradients were known to those in the golf ball field before the earliest priority date of the '707 patent (March 1996). The formation of a hardness gradient in the core is a natural result of the manufacturing process for solid rubber golf balls, and this too was well-known before the Bridgestone patents.

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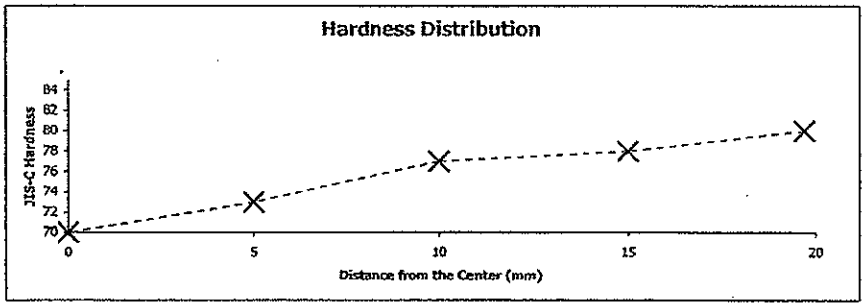
[6] *See* Ex. 28, M.H.R. Ghoreishy & G. Naderi, Three-dimensional Finite Element Modeling of a Rubber Curing Process, 37 J. Elastomers & Plastics 37 (Jan. 2005). In 1980, Prentice and Williams published a paper on modeling the state of cure in a vulcanized rubber article. *See* Ex. 29, G.A. Prentice & M.C. Williams, Numerical Evaluation of the State of Cure in a Vulcanizing Rubber Article, 53 Rubber Chem. Tech. 1023 (1980). In 1990, Kau and Petrusha published a paper on the formation gradients of other physical properties similar to hardness gradients during the molding process. *See* Ex. 30, H.T. Kau & L.A. Pertusha, Dimensional Stability and Property Gradients in Thick Sheet Molding Compound (SMC) Sections, 30 Polymer Engineering & Sci. 805 (July 1990). Lee has published research on calculating the temperature gradient created by the molding process in 1989, as well. *See* Ex. 31, C. Lee, Reaction and Thermal Analysis for SMC (Sheet Molding Compound) Molding in Complicated Geometries, 29 Polymer Engineering & Sci. 1051 (August 1989).

For example, U.S. Patent No. 6,645,496 (Ex. 32), which claimed priority from a 1993 Japanese patent application, shows the hardness distribution of example balls in Table 2 as follows:

TABLE 2

			Comparative Example No.				
			1	2	3	4	5
Core	Formulation	BR-01	100	100	100	100	100
		Zinc diacrylate	30	35	30	38	18
		Zinc Oxide	19	18	19	17.5	27
		Antioxidant	0.5	0.5	0.5	0.5	0.5
		Dicumyl peroxide	1.2	2.0	2.0	1.2	2.2
	Vulcanizing condition		140° C. × 25 min + 165° C. × 8 min	169° C. × 25 min	150° C. × 35 min	160° C. × 30 min	165° C. × 30 min
	Hardness distribution	Center	74	70	69	73	38
		Location which is 5 mm away from the center	75	73	75	76	54
		Location which is 10 mm away from the center	77	77	77	78	58
		Location which is 15 mm away from the center	78	78	80	84	65
		Surface	79	80	82	88	69
	Compression strength	(mm)	2.95	3.05	2.90	2.80	5.00
Cover	Formulation	Hi-milane 1605	50	50	50	50	50
		Hi-milane 1706	50	50	50	50	50
	Stiffness	Kgf/cm^2	3000	3000	3000	3000	3000
	Cover thickness	mm	1.6	1.6	1.6	1.6	1.6

Table 2 shows the hardness at several points between the center and the surface of the core.



Other examples of patents that disclose the presence of a core gradient in a golf ball prior to 1996 include U.S. Patent No. 4,714,253 (Ex. 33) (1987, showing a difference in hardness between the core center and a point 5 to 10 mm from the core center); U.S. Patent No. 5,002,281 (Ex. 34) (1991, showing a hardness at the core center and a point 5 to 10 mm from the core center); U.S. Patent No. 5,184,828 (Ex. 35) (1993, showing hardness in 5mm increments between the core

center and surface); U.S. Patent No. 5,711,723 (Ex. 36) (1995 application, showing a hardness gradient of not more than 4); and U.S. Patent No. 5,730,663 (Ex. 37) (1995 application, showing the hardness in 5mm increments between the core center and surface).

Still other patents show a gradient of greater than 22 degrees before the earliest priority date of the '791 patent (2000). Bridgestone's own U.S. Patent No. 5,830,085 (Ex. 38), for example, showed the use of a gradient of 5 to 25 degrees in a three-piece golf ball in 1998. United States Patent No. 6,390,935 (Ex. 39), filed in 1999, taught a gradient of 8 to 25 degrees. And U.S. Patent No. 6,386,993 (Ex. 40), also filed in 1999, claimed a gradient of 20 to 40 degrees.

3. Hardness Gradient in the Core Manufacturing Process

Solid golf ball cores are manufactured through a curing process. During the curing of a golf ball core, raw polybutadiene is mixed with, among other things, a crosslinking agent or catalyst and heated in a mold. The use of peroxide catalysts, such as dicumyl peroxide, is common in the golf ball art. As the mold is heated, the peroxide breaks down, forming free radicals, which then cause the strands of polybutadiene to form bonds, or "cross-link," with each other. As the temperature increases and the curing time increases, the crosslinking increases. Crosslinking increases the hardness of rubber.

During the core manufacturing process, the rubber is heated by conduction from the hot metal mold. Heat is transferred from the mold to the surface of the cores, and then is conducted inwards. Because polybutadiene has a low thermal conductivity, the surface of the core heats up appreciably faster than the center. Therefore, there is a pronounced temperature difference in the core, with the outside of the core initially being much hotter than the center.

Conventional core molding processes are usually stopped before the core reaches complete thermal equilibrium. Consequently, the outer portions are heated to temperatures where peroxide decomposition and rubber crosslinking occurs for a longer time than the inner

portions. As a result, greater crosslinking occurs at the outside of the core than at the inside. Thus, the outside of the core becomes harder than the center.

Core hardness gradients become larger as the core curing times are decreased, where other influencing factors remain constant. Most golf ball manufacturers try to produce as many balls as they can in a given amount of time. Therefore, there is a tendency in the industry to use the minimum amount of cure time which results in a good product. This results in balls which have hardness gradients.

4. Measuring the Core Hardness Gradient

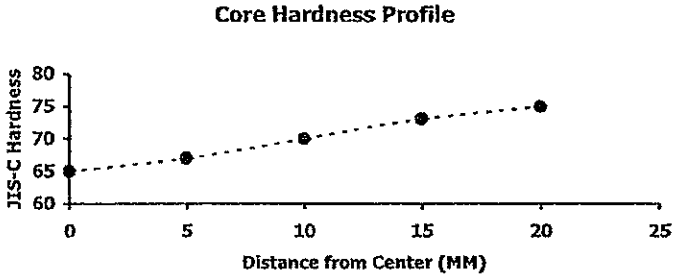
As already discussed, core hardness gradient is a measurement of how the hardness of the core rubber changes from the center of the core to the surface of the core.

Those in the golf ball art use an instrument called a durometer with a specially-shaped indenter to measure "hardness." The indenter is pressed against the core's surface with a defined force, and the durometer measures the amount of deflection of the surface in response to the force. This method of testing core hardness is described in various standards and specifies unique indenters and forces. JIS-C hardness refers to a standard published by the Japan Industry Standard. (*See* Ex. 41.) Shore-D hardness refers to a standard published by ASTM, International. (*See* Ex. 42.) The application of these tests to golf ball components is well-known in the golf ball art. It is understood that these tests are only repeatable to within several degrees, as the standard deviation within a laboratory is known to be roughly 0.8 degrees Shore D, and the reproducibility for tests conducted at different laboratories is roughly 16%.[7] Consequentially, a variation of several degrees between repeated tests of the same specimen is to be expected.

The core surface hardness is taken by first removing the golf ball's cover and intermediate layer, and placing the durometer directly on the core surface. In order to measure hardness at the center of the core, the core is first cut in half. *See* '707 Patent, Col. 7, ll. 8-12.

[7] *See* Ex. 42, ASTM D-2240, Table 4

The durometer is then applied to the center of the core. The hardness can be measured at other points between the center and the surface, as well. If the hardness is taken at many points between the center and the surface, it can be plotted, showing a hardness profile, as follows:



VIII. UNITED STATES PATENT NO. 5,782,707

The '707 patent discloses a three-piece solid golf ball comprising a solid core, an intermediate layer and a cover. Claim 1, the only asserted claim, reads:

> A three piece solid golf ball of the three layer structure comprising a solid core, an intermediate layer and a cover having a plurality of dimples in the ball surface wherein the solid core, intermediate layer, and cover each have a hardness as measured by a JIS-C scale hardness meter wherein the core center hardness is up to 75 degrees, the core surface hardness is up to 85 degrees, the core surface hardness is higher than the core center hardness by 8 to 20 degrees[8], the intermediate layer hardness is higher than the core surface hardness by at least 5 degrees, and the cover hardness is lower than the intermediate layer hardness by at least 5 degrees, and the dimples occupy at least 62% of the ball surface.

('707 Pat., Col. 10, ll. 55-67).

A. The '707 patent is anticipated by Bridgestone's 1994 Altus Newing Massy Golf Ball

I have concluded that claim 1 is invalid as anticipated by Bridgestone's own Altus Newing Massy golf ball. It is my understanding that Bridgestone sold the Altus Newing Massy in Japan since at least the fall of 1994 and that the Altus Newing Massy ball has been known and

[8] A degree is a unit of measurement on the JIS-C scale. JIS-C hardness is measured on a scale of zero to one hundred degrees.

B. The '707 Patent is Obvious in Light of European Patent 0 633 043

It is also my opinion that claim 1 of the '707 patent is invalid based on obviousness in light of the combination of European Patent 0 633 043, which discloses the claimed intermediate layer and core, and the knowledge of one skilled in the art.

EP 0 633 043 ("EP 043") (Ex. 47) issued on April 6, 1997 to Bridgestone, naming Hiroshi Higuchi, Hisashi Yamagishi, and Yoshinori Egashira as inventors of this patent. Mr. Yamagishi and Mr. Higuchi are also the two inventors on the '707 Patent. The EP '043 claims priority to a Japanese application filed in August 1993. As EP '043 claims priority before the priority date of the '707 patent (March 1996), I understand that EP '043 is prior art under 35 U.S.C. § 102(a).

EP '043 claims a three-piece solid golf ball that has a solid core, an intermediate layer and an outer cover layer, just like the golf ball disclosed in the '707 patent. The ball has an intermediate layer which is hard relative to the cover and the core. *See* [0010]. The purpose of the invention is to provide good flight performance, control, feel, and durability. *See* [0009].

The EP 043 patent teaches a core which is formed from a "well known rubber composition." *See* [0017]. Just like the '707 patent, the EP 043 patent provides the core recipe, core diameter, curing time, and curing temperature. *See* Table 1; [0023]. The specification discusses a core hardness of 45 to 80 degrees. *See* [0011].

The EP 043 reference provides nine example balls, and provides detailed instruction as to their manufacture. These instructions include the core composition, curing time, and curing temperature. Table 2 of the EP 043 patent discloses the resulting measurements for the cover hardness, intermediate layer hardness, and core surface hardness of the example balls... Although the inventors did not disclose the core center hardness of the example balls, based upon the teachings of the specification, one of ordinary skill in the art can easily determine that value.

The engineers followed the directions in the EP '043 patent to make and measure the properties of the core. Because the EP '043 patent's instructions are just as detailed as those of

the '707 patent, one of ordinary skill should get a consistent core center hardness by following the instructions in the patent.[15] The engineers manufactured a core and measured the core center hardness at 50.2 degrees. The core had a surface hardness of 67.4 degrees, which is equivalent to the example hardness of 66 degrees in light of the repeatability of durometer measurements.[16]

a. "wherein the core center hardness is up to 75 degrees"

The center hardness of the core manufactured in accordance with the recipe and curing conditions disclosed in EP '043 was 50.2 degrees, which meets this limitation.

b. "the core surface hardness is up to 85 degrees"

In Example 2 of Table 2, the EP '043 patent discloses a core with a surface hardness of 66 degrees, which meets this limitation.

c. "the core surface hardness us higher than the core hardness by 8 to 20 degrees"

The hardness gradient of the core manufactured in accordance with the recipe and curing conditions disclosed in EP '043 was 17.2 degrees, which meets this limitation.

d. "The intermediate layer hardness is higher than the core surface hardness by at least 5 degrees"

Example 2 of Table 2 discloses a core with a surface hardness of 66 degrees and an intermediate layer hardness of 91 degrees. This yields a difference of 25 degrees, which is well within the claimed range.

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[15] That is, the variation in the results should be consistent with the measurement variation which I discussed above. In addition, since Acushnet owns English-unit molds, the tests used a 35.28 mm core mold in lieu of the 35.31 mm diameter specified in the patent. The difference between these diameters on core hardness is miniscule (0.09%).

[16] The relative repeatability of the Shore-D durometer measurement is 15.7%. *See* ASTM D-2240 (Ex. 42). The JIS-C test has a similar repeatability.

e. "the cover hardness is lower than the intermediate layer hardness by at least 5 degrees"

Table 2 shows that Example 2 has a cover hardness of 82 degrees. *See* Table 2. This is nine degrees lower than the intermediate layer hardness, and therefore meets this limitation.

f. "the dimples occupy at least 62% of the ball surface"

It would have been obvious to one of ordinary skill in the art in March of 1996 to use a dimple pattern of at least 62% when constructing Example 2 in Table 2. The EP '043 does not disclose the dimple coverage of the Example 2 ball. However, it evaluated the flying performance of the example balls, *see* [0027], and example 2 demonstrated good flying performance. *See* Table 2. One of ordinary skill in the golf ball art would recognize that, for a ball to have good flying performance, it would have to have dimples. Therefore, one of ordinary skill in the golf ball are would have looked to what was common in the golf ball art at the time the patentee filed the application that resulted in the EP '043 patent and use a comparable design.

Exhibit 48 is a summary of the percentage dimple coverage for a variety of golf balls from 1992 through 1994, and was generated from Acushnet's competitive test data. During that time period, I understand that Acushnet personnel routinely measured dimple characteristics of competitive golf balls using a profilometer device. Exhibit 48 lists percentage dimple coverage of numerous competitively tested balls, which have been calculated using the phantom sphere method described in the '707 specification. *See* Col. 5, l. 35 – col. 6, l. 15.

As Exhibit 48 shows, almost all of the competitive balls considered between 1992 and 1994 had dimple surface coverages well in excess of 62%. Dimple surface coverage has increased over time – so it would have been obvious to use at least surface coverage as was common at that time – not less. Consequentially, it would have been obvious to one of ordinary skill in the art to use a dimple pattern with at least 62% dimple coverage.

higher than the hardness at its center point by 8 degrees, preferably by 10 degrees. Col. 3, ll. 3 – 8. The difference in hardness is preferably 25 degrees or smaller. Col. 3, ll. 22 – 24. Organic sulfide compounds may be used in the center. Col. 4, ll. 66 – 68. Dimples are formed into the ball's cover. Col. 8, ll. 42-43.

Each of claim 11, 13, 16, and 26 of the '791 patent is obvious by the combination of the '935 patent with the '563 patent and/or the '247 patent. Each reference is generally directed to the same problem of obtaining good flight distance and controllability. The '563 patent is directed to improving the flying distance, controllability, straight travel and roll of the golf ball. Col. 1, ll. 55-57. The '247 patent is directed toward improving flight distance, control, feel, and durability. Col. 2, ll. 11-16. The '935 patent is directed towards good flight distance, controllability, and feel. Col. 2, ll. 10-14. All three patents teach the use of three-piece golf balls.

The '935 patent teaches that having a hardness gradient less than 8 would result in having either a poor shot feeling, poor durability, or poor flight distance. Col. 3, ll. 3-22. The patent also teaches that a hardness gradient of up to 25 degrees is preferred. Col. 3, ll. 21-23. It would be obvious to use a core with this hardness gradient to obtain the shot feeling, durability, and flight distance desired in the '247 and '563 patents.

E. The '791 Patent is neither Enabled nor Supported by the Written Description

The '791's specification shows that Bridgestone did not invent any technology embodied in the '791 patent which fulfills the entire range of the claim limitation, "[said elastic core] has a difference in JIS-C hardness of at least 22."

The maximum theoretical core hardness gradient is about 100 degrees.[34] However, technology that can create such a gradient is not known in the art. There are limits on what is

[34] There is a theoretical upper limit of core hardness gradient. You would achieve this limit by curing the core in such a manner that the outer surface is completely vulcanized and is made as hard as possible, and the center is completely uncured. I can assume that the completely vulcanized rubber could be made to have nearly the

generally known to be achieved in curing a single piece of polybutadiene. Conventional techniques have an upper limit on the gradient that they can achieve.

The specification does not describe the use of any technology that would yield gradients in excess of 40 or 50 degrees. Golf ball cores can be *single layer*, or made from a single piece of polybutadiene, or *multilayer*, or made of two or more layers of polybutadiene. A multilayer core can have a larger core gradient, because a soft inner rubber can be wrapped inside a different, harder, outer rubber. The Pro V1x, which has a soft inner core surrounded by a hard outer core, is an example of a multi-layer ball. Because a single layer core is made of one material, however, its gradient can only be made through curing the core in a non-uniform manner. There is a limit to how soft the center can be kept while still curing the outer cover.

I agree with Mr. Shimosaka of Bridgestone that obtaining a gradient of over forty in a single layer core would require a new idea or technology which is not currently known in the golf ball art, and certainly was not disclosed in the specification of the '791 patent.

> Q. Now, if you wanted to create a single-layer core that had a very high gradient, let's say 40, that would involve a significant amount of experimentation to try to make that work, right? . . .
>
> ***A. Well, rather than any significant amount of experimentation I think that would require an innovative conception of idea or technology.***

11/16/2006 Deposition of Hirotaka Shimosaka 56:10 to 56:20

The specification of the '791 patent is directed towards single-core balls. It only discusses single cores – it never mentions the use of multiple core layers. The patent emphasizes the necessity of a "gradually increasing" hardness profile.[35] A multilayer core cannot have a gradually increasing hardness – its hardness takes a distinct jump between the softer inner core

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maximum hardness measurable on the JIS-C scale, 100 degrees, and that the uncured rubber would have nearly the minimum, zero degrees. Therefore, the maximum theoretical hardness gradient can never exceed 100 degrees.

[35] *See* Col. 2, ll. 6-9; col. 4, ll. 1-5. The only originally filed claim was directed towards cores with a gradually increasing hardness. *See* Originally Filed Specification at 15. Independent claims 13 and 24, which did not have this limitation, were added later by amendment. *See* August 15, 2002 Amendment.

and harder outer layer. Because the specification emphasizes the use of a gradually increasing hardness, it clearly does not address the use of multilayer cores like that in the Pro V1x.

The specification of the '791 patent does not teach the use of cores with gradients over 30. In fact, it teaches away from cores with gradients over 30. It teaches that the upper limit of the hardness difference is "at most 30, preferably 27 or less, and most preferably 25 units or less." Col. 3, ll. 43-45. Table 3 shows three Example cores and six Comparative Examples. *See* Table 3. All of these examples have gradients of 24 or less.

TABLE 3

			Example			Comparative Example				
			1	2	3	1	2	3	4	5
Core	Composition (pbw)	1,4-cis-Polybutadiene	100	100	100	100	100	100	100	100
		Zinc diacrylate	41.0	38.0	35.0	28.0	27.8	38.0	32.1	28.4
		Peroxide (1)[1)]	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
		Peroxide (2)[2)]	0.8	0.8	0.8	0.6	0.6	0.8	0.8	0.8
		Sulfur[3)]	0.1	0.1	0.1	0	0	0.1	0.1	0.1
		Antioxidant[4)]	0	0	0	0.2	0.2	0	0	0
		Barium sulfate	24.1	25.2	26.4	29.8	29.9	25.2	12.8	14.4
		Zinc oxide	5	5	5	5	5	5	5	5
		Zinc salt of pentachlorothiophenol	1	1	1	0.2	0.2	1	1	1
	Vulcanization conditions	Primary Temperature (° C.)	175	175	175	140	155	175	175	175
		Primary Time (min)	15	15	15	30	15	15	15	15
		Secondary Temperature (° C.)	—	—	—	165	—	—	—	—
		Secondary Time (min)	—	—	—	15	—	—	—	—
	Hardness	Surface (JIS-C hardness)	85	83	78	76	76	83	87	80
		Center (JIS-C hardness)	61	59	55	72	60	59	63	56
		JIS-C hardness difference	24	24	23	4	16	24	24	24
	Deformation under loading (mm)[5)]		3.4	3.8	4.1	3.3	3.4	3.8	3.4	4.1

The '791 patent is not enabled. It only teaches one how to use single core technology. That technology cannot create cores with gradients much over 40. This comes nowhere near the theoretical limit of what a core gradient can be.

Furthermore, the claims of the '791 patent are not supported by a written description which shows that Bridgestone actually possessed any technology which could create cores with a gradient significantly over 22. First, the patent does not give any example gradients over 25, and states that gradients over 30 are not preferred. Second, the patent only teaches the use of single-

layer cores, a technology that can only obtain gradients of up to around 40. There is nothing in the specification to indicate that Bridgestone was able to produce cores with a gradient over 40.

F. No Secondary Considerations of Non-Obviousness Are Present

It is my understanding that a patent holder may rely on objective indicia of non-obviousness, known as secondary considerations, to try and preserve the validity of its patents. In forming my opinion regarding the asserted claims of the 852, '817, '707, '834 and '791 (the "Bridgestone patents"), I have considered whether any of these secondary considerations are present. I have reviewed Bridgestone's Ninth Supplemental Response to Acushnet's Interrogatory No. 10. In that response, Bridgestone generally contends that all of its asserted patents are non-obvious for the following reasons: (a) the alleged inventions led to unexpectedly better performance results; (b) Acushnet copied Bridgestone's technology; and (c) Acushnet's golf balls were commercially successful. In addition, Bridgestone specifically asserts that the '852, '707 and '791 patents are non-obvious because of Acushnet's failure to produce golf balls with 2 layer covers, that the '834 patent is non-obvious because of the claimed invention's commercial success and that the '852 and '707 patents are non-obvious because Bridgestone licensed those patents to Callaway.

It is my understanding that for objective indicia of non-obviousness to be significant there must be a connection or nexus between the claimed features of the invention and the particular secondary consideration. In its interrogatory response, Bridgestone did not describe or explain a connection between any objective indicia of non-obviousness and claimed inventions.

For example, Bridgestone does not explain how the commercial success of any Bridgestone or Acushnet golf ball was the result of a claimed feature of any Bridgestone patent.

It is my opinion that there can be no nexus between the asserted claims of the Bridgestone patents and the commercial success of Acushnet's current products if Acushnet does not infringe the asserted claim of any of these patents. This fact is also evidence that Acushnet could not have copied the asserted claims of the Bridgestone patents.

In addition, Bridgestone's Interrogatory response does not describe or explain how Acushnet's failure to produce golf balls with two-layer covers was related in any way to a failure to use the claimed features of the '852, '707 or '791 patents. Nor does Bridgestone describe any nexus between the performance of its golf balls and the claimed features of its patents.

Finally, I understand that Callaway licensed the '852 and '707 patents in connection with the settlement of a lawsuit with Bridgestone, but this license does not indicate to me that the claimed inventions were a commercial success. Bridgestone did not describe or explain that Callaway licensed those patents based on the claimed features of the '852 and '707 patents.

In the absence of any explanation of how the secondary considerations are related to the features of the Bridgestone patents, I cannot give Bridgestone's assertions any significant weight. With respect to the '791 patent, considering the minor differences between the patent and the teachings of the '563 and '247 patents, secondary considerations of obviousness (if any are even found to be present) are of minor significance in comparison to the evidence of obviousness. The fact that the '563 and '247 patents clearly possess all of the claimed features of the '791 patent when routine optimization is used to obtain core curing conditions is strong and overwhelming proof of obviousness even if some secondary indicia of obviousness exists.

Therefore, it is my conclusion that the asserted claims of the Bridgestone patents are obvious for the reasons set forth above.

XI. CONCLUSION

I reserve the right to supplement this report should new information come to light that bears on my opinions contained in this report. I reserve the right to supplement or modify this report, if appropriate, to the extent that new or additional information is provided. I also reserve the right to consider and comment on additional evidence that may be presented by experts for Bridgestone.

At trial or any hearing in this litigation, I may provide demonstrative aids, such as computer animations, excerpts from relevant exhibits, deposition testimony, and physical examples, to assist in explaining the subject matter discussed in this report.

Signed this sixteenth day of January, 2007.

David Felker, Ph.D.

EXHIBIT 4

UNITED STATES DISTRICT COURT
DISTRICT OF DELAWARE

BRIDGESTONE SPORTS CO., LTD., and BRIDGESTONE GOLF, INC., Plaintiffs, v. ACUSHNET COMPANY, Defendant.	Case No. 05-CA-132 (JJF) **INVALIDITY EXPERT REPORT OF DR. JACK KOENIG**
ACUSHNET COMPANY, Counterclaimant, v. BRIDGESTONE SPORTS CO., LTD., and BRIDGESTONE GOLF, INC., Counterdefendant.	

was in public use and on sale before Bridgestone filed the '961 application is further evidence that the golf ball's commercial success cannot be attributed to the claimed invention. Both of these facts are also evidence that Acushnet could not have copied the asserted claims.

299. Bridgestone's Interrogatory response also does not describe or explain how Acushnet's failure to produce golf balls with 2-layer covers related in any way to a failure to use the claimed features of the '652 patent. Nor does Bridgestone describe any nexus between the performance of its golf balls and the claimed features of either the '652 or '961 patent.

300. In the absence of any explanation of how the secondary considerations are related to the features of the '961 and '652 patents, I cannot give Bridgestone's assertions any significant weight. Also, in connection with the '652 patent, the elements of the asserted claims were so widely known in the prior art that such evidence would not change my opinion regarding the '652 patent.

301. As such, it is my conclusion that the asserted claims of the '652 and '961 patents are obvious for the reasons set forth above.

X. GRADIENTS

302. Gradients in rubber have necessarily existed from the first time rubber articles were fabricated over a hundred years ago. In short, a gradient is an inherent quality of rubber that one of ordinary skill in the golf ball art in 1995 would understand.

303. When rubber articles, like golf balls, are fabricated, the uncrosslinked rubber and other ingredients such as fillers, crosslinking agents, etc., are mixed together and inserted into a mold.

304. The mold is held at the cure temperature, which depends on the decomposition temperature of the crosslinking agent, i.e., a peroxide. The surface of the rubber, which would be in contact with the walls of the mold, will be exposed to an elevated temperature, i.e. the temperature required to decompose the peroxide into free radicals required to cure (crosslink) the rubber.

305. Because rubber is a thermal insulator, it has a low capacity to conduct temperature. As a result, a thermal gradient in the rubber is developed, in which the surface in contact with the mold is at a higher temperature than the interior parts of the rubber.

306. As a consequence, the curing will begin at the surface immediately, but will not begin at the core until the core reaches a sufficiently high temperature to decompose its crosslinking agent.

307. In other words, the rate of the curing reaction is a function of temperature, i.e. the higher the temperature the faster the kinetic reaction of curing. Because the core is at a lower temperature than the surface, the curing reaction at the core is slower than at the surface. Therefore there is a gradient in the degree of cure in the molded rubber article from the surface to the center.

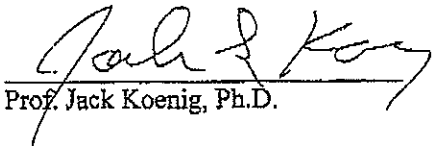
308. This will produce a gradient hardness in the physical and mechanical properties of the rubber from the center to the surface. Thus, for a golf ball, there will always be a gradient in hardness and other physical and mechanical properties from the core to the surface with the surface being higher. This gradient will be greater when the mold temperature is higher and the thickness of the rubber article is large, i.e. like a golf ball.

XI. CONCLUSION

309. I reserve the right to supplement this report should new information come to light that bears on my opinions contained in this report. I reserve the right to supplement or modify this report, if appropriate, to the extent that new or additional information is provided. I also reserve the right to consider and comment on additional evidence that may be presented by experts for Bridgestone.

310. At trial or any hearing in this litigation, I may provide demonstrative aids, such as computer animations, excerpts from relevant exhibits, deposition testimony, and physical examples, to assist in explaining the subject matter discussed in this report.

Signed this sixteenth day of January, 2007.



Prof. Jack Koenig, Ph.D.

EXHIBIT 5

US005782707A

United States Patent [19]

Yamagishi et al.

[11] Patent Number: 5,782,707

[45] Date of Patent: Jul. 21, 1998

[54] **THREE-PIECE SOLID GOLF BALL**

[75] Inventors: **Hisashi Yamagishi**; **Hiroshi Higuchi**, both of Chichibu, Japan

[73] Assignee: **Bridgestone Sports Co., Ltd.**, Tokyo, Japan

[21] Appl. No.: **812,925**

[22] Filed: **Mar. 10, 1997**

[30] **Foreign Application Priority Data**

Mar. 11, 1996 [JP] Japan 8-082121

[51] **Int. Cl.**[6] **A63B 37/06**; A63B 37/12; A63B 37/14

[52] **U.S. Cl.** **473/374**; 473/373

[58] **Field of Search** 473/373, 374, 473/378, 384

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5,688,191	11/1997	Cavallaro et al.	473/373

Primary Examiner—George J. Marlo

Attorney, Agent, or Firm—Sughrue, Mion, Zinn, Macpeak & Seas, PLLC

[57] **ABSTRACT**

The invention provides a three-piece solid golf ball featuring an increased flight distance on driver shots and improved control on approach shots. In a three-piece solid golf ball consisting of a solid core, an intermediate layer, and a cover, provided that hardness is measured by a JIS-C scale hardness meter, the core center hardness is up to 75 degrees, the core surface hardness is up to 85 degrees, the core surface hardness is higher than the core center hardness by 8 to 20 degrees, the intermediate layer hardness is higher than the core surface hardness by at least 5 degrees, and the cover hardness is lower than the intermediate layer hardness by at least 5 degrees.

6 Claims, 2 Drawing Sheets

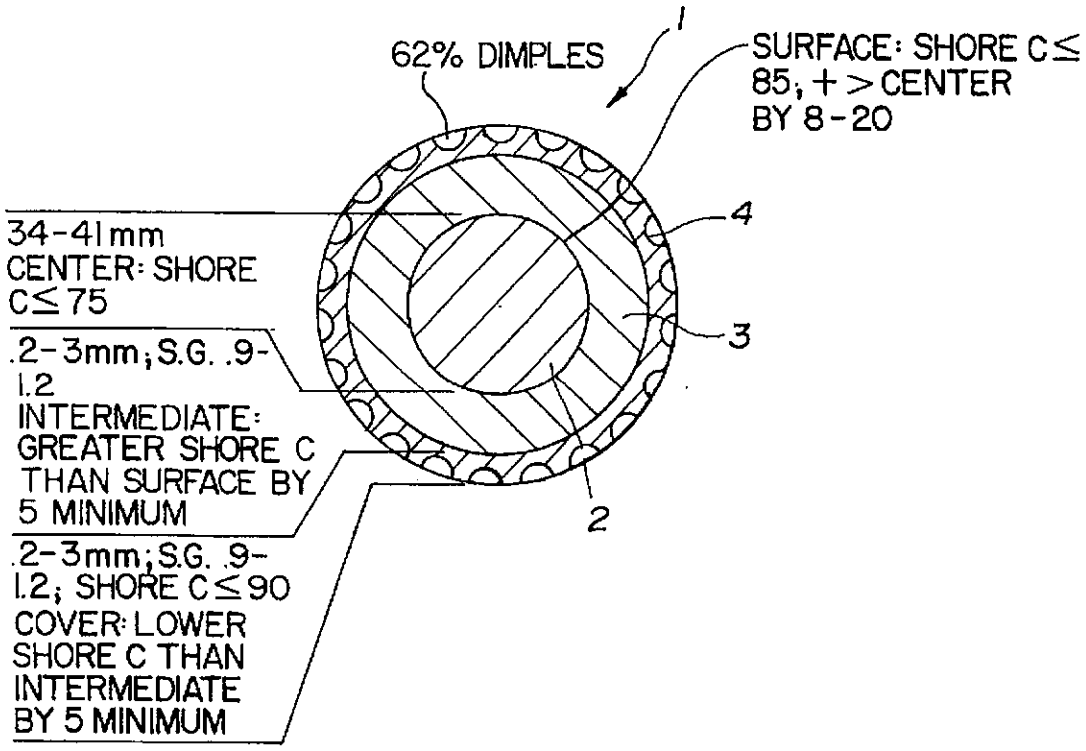


FIG.1

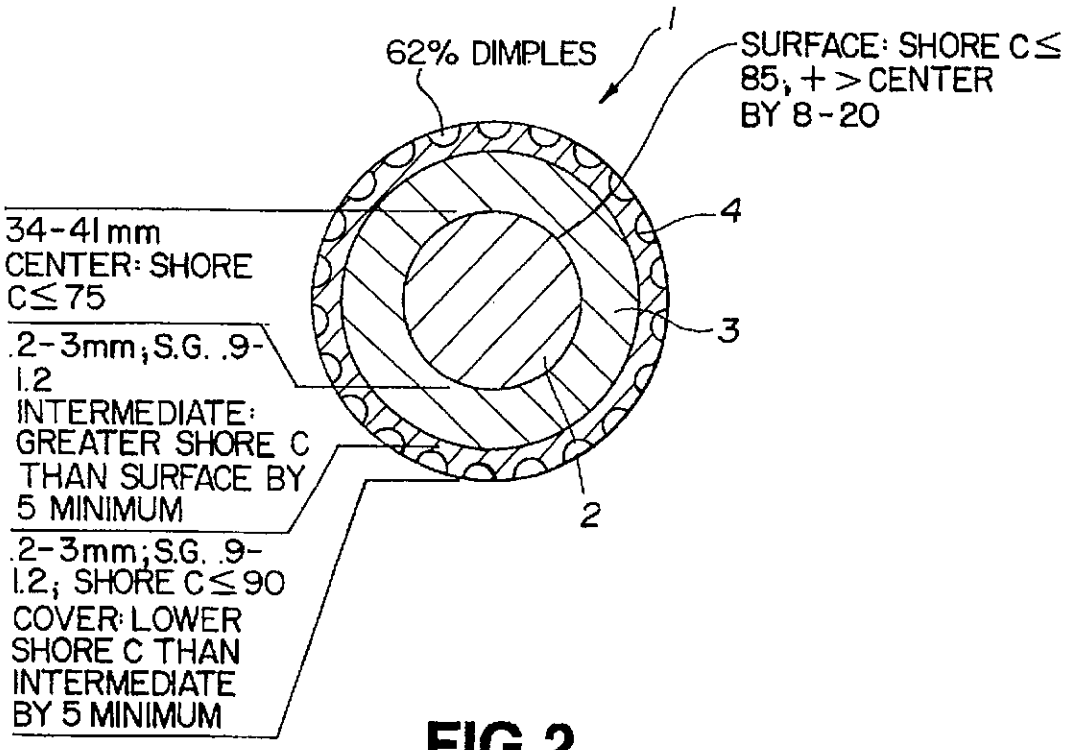

62% DIMPLES
1
SURFACE: SHORE C≤ 85, + > CENTER BY 8-20
4
34-41 mm CENTER: SHORE C≤75
3
.2-3mm; S.G. .9-1.2 INTERMEDIATE: GREATER SHORE C THAN SURFACE BY 5 MINIMUM
2
.2-3mm; S.G. .9-1.2; SHORE C≤90 COVER: LOWER SHORE C THAN INTERMEDIATE BY 5 MINIMUM

FIG.2

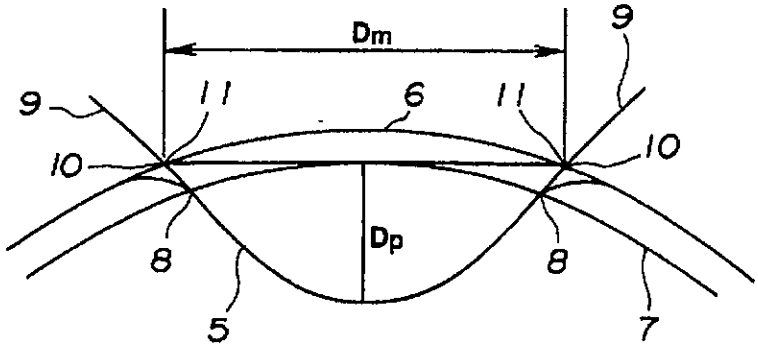

Dm
9
9
11
6
11
10
10
Dp
8
8
5
7

FIG.3

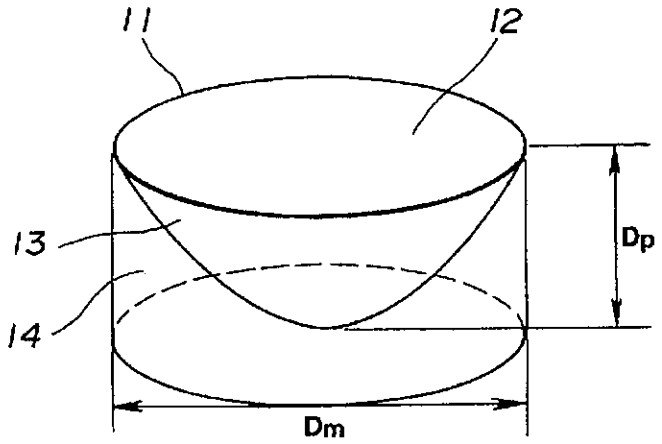
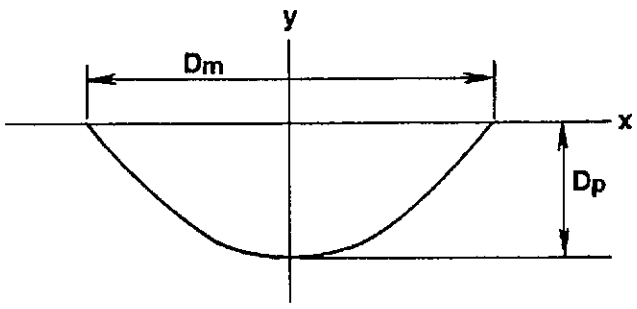


FIG.4



THREE-PIECE SOLID GOLF BALL

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a three-piece solid golf ball of the three-layer structure comprising a solid core, an intermediate layer, and a cover and more particularly, to such a three-piece solid golf ball which features an increased flight distance on full shots with a driver and improved control on approach shots with No. 5 iron or sand wedge.

2. Prior Art

From the past, two-piece solid golf balls consisting of a solid core and a cover are used by many golfers because of their flight distance and durability features. In general, two-piece solid golf balls give hard hitting feel as compared with wound golf balls, and are inferior in feel and control due to quick separation from the club head. For this reason, many professional golfers and skilled amateur golfers who prefer feel and control use wound golf balls rather than two-piece solid golf balls. The wound golf balls are, however, inferior in carry and durability to the solid golf balls.

More particularly, when two-piece solid golf balls are subject to full shots with a club having a relatively large loft angle, the ball flight is mainly governed by the club loft rather than the ball itself so that spin acts on most balls to prevent the balls from too much rolling. However, on approach shots over a short distance of 30 to 50 yards, rolling or control substantially differs among balls. The major cause of this difference is not related to the basic structure of the ball, but to the cover material. Then some two-piece solid golf balls use a cover of a relatively soft material in order to improve control on approach shots, but at the sacrifice of flight distance.

Controllability is also needed on full shots with a driver. If a soft cover is used as a result of considering too much the purpose of improving spin properties upon control shots such as approach shots with No. 5 iron and sand wedge, hitting the ball with a driver, which falls within an increased deformation region, will impart too much spin so that the ball may fly too high, resulting in a rather reduced flight distance. On the other hand, if the spin rate is too low, there arises a problem that the ball on the descending course will prematurely drop, adversely affecting the ultimate flight distance too. As a consequence, an appropriate spin rate is still necessary upon driver shots.

Anyway, the prior art two-piece solid golf balls fail to fully meet the contradictory demands of players, the satisfactory flight performance that the ball acquires an adequate spin rate upon full shots with a driver and the ease of control that the ball acquires a high spin rate upon approach shots with No. 5 iron and sand wedge.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a three-piece solid golf ball which features an increased flight distance on full shots with a driver and improved control on approach shots with No. 5 iron or sand wedge.

Making extensive investigations on a three-piece solid golf ball of the three-layer structure comprising a solid core, an intermediate layer, and a cover, we have found that the above object is attained by optimizing the hardness distribution of the core, forming a hard intermediate layer between the core and the soft cover, and adjusting a percent dimple surface occupation. By virtue of the synergistic effect of these factors, the resulting golf ball travels an increased flight distance on full shots with a driver and is well controllable on approach shots with No. 5 iron or sand wedge.

More specifically, we have found that the following advantages are obtained in a three-piece solid golf ball of the three-layer structure comprising a solid core, an intermediate layer, and a cover, when the solid core, intermediate layer, and cover each have a hardness as measured by a JIS-C scale hardness meter, the core center hardness is up to 75 degrees, the core surface hardness is up to 85 degrees, the core surface hardness is higher than the core center hardness by 8 to 20 degrees, the intermediate layer hardness is higher than the core surface hardness by at least 5 degrees, and the cover hardness is lower than the intermediate layer hardness by at least 5 degrees. Upon deformation in an increased deformation region (associated with full shots with a driver), the presence of a hard intermediate layer between a soft deformable cover and a soft core ensuring soft feel is effective for reducing the energy loss by excessive deformation of the core and thereby enabling to form a structure of efficient restitution while maintaining the softness of the ball as a whole. Then the ball will travel an increased flight distance upon full shots with a driver. Although a soft cover is used, the ball gains an appropriate spin rate and is free of shortage of flight distance. At the same time, in a reduced deformation region (associated with approach shots), the ball gains an increased spin rate and is well controllable. Additionally, by adjusting dimples such that the percent surface occupation of dimples in the cover surface is at least 62% and an index (Dst) of overall dimple surface area is at least 4, and optimizing the dimple pattern, the flight properties (flight distance and flight-in-wind) of the golf ball are further enhanced. By virtue of the synergistic effect of these factors, the resulting golf ball covers an increased flight distance on full shots with a driver and is well controllable on approach shots with No. 5 iron or sand wedge, that is, satisfies the contradictory demands of players.

Therefore, according to the present invention, there is provided a three-piece solid golf ball of the three-layer structure comprising a solid core, an intermediate layer, and a cover, having a plurality of dimples in the ball surface. Provided that the solid core at its surface and center, the intermediate layer, and the cover each have a hardness as measured by a JIS-C scale hardness meter, the core center hardness is up to 75 degrees, the core surface hardness is up to 85 degrees, the core surface hardness is higher than the core center hardness by 8 to 20 degrees, the intermediate layer hardness is higher than the core surface hardness by at least 5 degrees, and the cover hardness is lower than the intermediate layer hardness by at least 5 degrees. The dimples occupy at least 62% of the ball surface.

In one preferred embodiment, the dimples in the ball surface total in number to 360 to 450 and include at least two types of dimples having different diameters. An index (Dst) of overall dimple surface area given by the following expression (1) is at least 4,

$$Dst = \frac{n \sum_{k=1}^{n} [(Dmk^2 + Dpk^2)\pi V_0 kNk]}{4R^2} \quad (1)$$

wherein R is a ball radius, n is the number of dimple types, Dmk is a diameter of dimples k, Dpk is a depth of dimples k, Nk is the number of dimples k wherein k=1, 2, 3, . . . n, and V_0 is the volume of the dimple space below a plane circumscribed by the dimple edge divided by the volume of a cylinder whose bottom is the plane and whose height is the maximum depth of the dimple from the bottom.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic cross-sectional view of a three-piece solid golf ball according to one embodiment of the invention.

FIG. 2 is a schematic cross-sectional view of a dimple illustrating how to calculate V_0.

FIG. 3 is a perspective view of the same dimple.

FIG. 4 is a cross-sectional view of the same dimple.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIG. 1, a three-piece solid golf ball 1 according to the invention is illustrated as comprising a solid core 2 having an optimized hardness distribution, a hard intermediate layer 3, and a soft cover 4.

In the golf ball 1 of the invention, the hardness distribution of the solid core 2 is optimized. More particularly, the core 2 is formed to have a center hardness of up to 75 degrees, preferably 60 to 73 degrees, more preferably 63 to 69 degrees as measured by a JIS-C scale hardness meter. The core 2 is also formed to have a surface hardness of up to 85 degrees, preferably 70 to 83 degrees, more preferably 73 to 80 degrees. If the core center hardness exceeds 75 degrees and the surface hardness exceeds 85 degrees, the hitting feel becomes hard, contradicting the object of the invention. It is noted that the hardness referred to herein is JIS-C scale hardness unless otherwise stated.

The core is formed herein such that the surface hardness is higher than the center hardness by 8 to 20 degrees, preferably 10 to 18 degrees. A hardness difference of less than 8 degrees would result in a hard hitting feel provided that the ball hardness and the core surface hardness are fixed. A hardness difference of more than 20 degrees would fail to provide sufficient restitution provided that the ball hardness and the core surface hardness are fixed. The hardness distribution establishing such a hardness difference between the surface and the center of the core ensures that the core surface formed harder than the core center is effective for preventing excessive deformation of the core and efficiently converting distortion energy into reaction energy when the ball is deformed upon impact. Additionally, a pleasant feeling is obtainable from the core center softer than the core surface.

The hardness distribution of the solid core is not limited insofar as the core is formed such that the core surface is harder than the core center by 8 to 20 degrees. It is preferable from the standpoint of efficient energy transfer that the core is formed such that the core becomes gradually softer from its surface toward its center.

The solid core preferably has a diameter of 34 to 41 mm, especially 34.5 to 40 mm. No particular limit is imposed on the overall hardness, weight and specific gravity of the core and they are suitably adjusted insofar as the objects of the invention are attainable. Usually, the core has an overall hardness corresponding to a distortion of 2.5 to 4.5 mm, especially 2.8 to 4 mm under a load of 100 kg applied, and a weight of 20 to 40 grams, especially 23 to 37 grams.

In the practice of the invention, no particular limit is imposed on the core-forming composition from which the solid core is formed. The solid core may be formed using a base rubber, a crosslinking agent, a co-crosslinking agent, and an inert filler as used in the formation of conventional solid cores. The base rubber used herein may be natural rubber and/or synthetic rubber conventionally used in solid golf balls although 1,4-cis-polybutadiene having at least

40% of cis-structure is especially preferred in the invention. The polybutadiene may be blended with a suitable amount of natural rubber, polyisoprene rubber, styrenebutadiene rubber or the like if desired. The crosslinking agent includes organic peroxides such as dicumyl peroxide, di-t-butyl peroxide, and 1,1-bis(t-butylperoxy)-3,3,5-trimethylcyclohexane, with a blend of dicumyl peroxide and 1,1-bis(t-butylperoxy)-3,3,5-trimethylcyclohexane being preferred. In order to form a solid core so as to have the above-defined hardness distribution, it is preferable to use a blend of dicumyl peroxide and 1,1-bis(t-butylperoxy)-3,3,5-trimethylcyclohexane as the crosslinking agent and the step of vulcanizing at 160° C. for 20 minutes. It is noted that the amount of the crosslinking agent blended is suitably determined although it is usually about 0.5 to 3 parts by weight per 100 parts by weight of the base rubber. The co-crosslinking agent used herein is not critical. Examples include metal salts of unsaturated fatty acids, inter alia, zinc and magnesium salts of unsaturated fatty acids having 3 to 8 carbon atoms (e.g., acrylic acid and methacrylic acid), with zinc acrylate being especially preferred. Examples of the inert filler include zinc oxide, barium sulfate, silica, calcium carbonate, and zinc carbonate, with zinc oxide and barium sulfate being often used. The amount of the filler blended is usually up to 40 parts by weight per 100 parts by weight of the base rubber although the amount largely varies with the specific gravity of the core and cover, the standard weight of the ball, and other factors and is not critical. In the practice of the invention, the overall hardness and weight of the core can be adjusted to optimum values by properly adjusting the amounts of the crosslinking agent and filler (typically zinc oxide and barium sulfate) blended.

The core-forming composition obtained by blending the above-mentioned components is generally milled in a conventional mixer such as a Banbury mixer and roll mill, compression or injection molded in a core mold, and then heat cured under the above-mentioned temperature condition, whereby a solid core having an optimum hardness distribution is obtainable.

The intermediate layer 3 enclosing the core 2 is preferably formed to a JIS-C hardness of 75 to 100 degrees, more preferably 80 to 98 degrees. The intermediate layer is formed to a hardness higher than the core surface hardness by at least 5 degrees, preferably 5 to 20 degrees, more preferably by 7 to 18 degrees. A hardness difference of less than 5 degrees would fail to provide sufficient restitution whereas a hardness difference of more than 20 degrees would result in a dull and rather hard hitting feel. The restitution of the core can be maintained by forming the intermediate layer to a higher hardness than the core surface hardness.

The gage, specific gravity and other parameters of the intermediate layer may be properly adjusted insofar as the objects of the invention are attainable. Preferably the gage is 0.2 to 3 mm, especially 0.7 to 2.3 mm and the specific gravity is 0.9 to less than 1.2, especially 0.94 to 1.15.

Since the intermediate layer 3 serves to compensate for a loss of restitution of the solid core which is formed soft, it is formed of a material having improved restitution insofar as a hardness within the above-defined range is achievable. Use is preferably made of a blend of ionomer resins such as Himilan (manufactured by Mitsui-duPont Polychemical K.K.) and Surlyn (E.I. duPont) as will be described later in Table 2. An intermediate layer-forming composition may be obtained by adding to the ionomer resin, additives, for example, an inorganic filler such as zinc oxide and barium sulfate as a weight adjuster and a coloring agent such as titanium dioxide.

The cover **4** enclosing the intermediate layer **3** must be formed to a lower hardness than the intermediate layer. That is, the cover has a hardness lower than the intermediate layer hardness by at least 5 degrees. Additionally, the cover is preferably formed to a JIS-C hardness of up to 90 degrees, more preferably 70 to 90 degrees, most preferably 75 to 87 degrees when spin properties in an approach range are of much account. A cover hardness in excess of 90 degrees on JIS-C scale would adversely affect the spin properties in an approach range so that professional and skilled amateur players who prefer accurate control reject use in the game. A cover hardness of less than 70 degrees would result in a ball losing restitution.

The gage, specific gravity and other parameters of the cover may be properly adjusted insofar as the objects of the invention are attainable. Preferably the gage is 0.2 to 3 mm, especially 0.7 to 2.3 mm and the specific gravity is 0.9 to less than 1.2, especially 0.93 to 1.15. The gage of the intermediate layer and cover combined is preferably 2 to 4.5 mm, especially 2.2 to 4.2 mm.

The cover composition is not critical and the cover may be formed of any of well-known stock materials having appropriate properties as golf ball cover stocks. For example, ionomer resins, polyester elastomers, and polyamide elastomers may be used alone or in admixture with urethane resins and ethylene-vinyl acetate copolymers. Thermoplastic resin base compositions are especially preferred. UV absorbers, antioxidants and dispersing aids such as metal soaps may be added to the cover composition if necessary. The method of applying the cover is not critical. The cover is generally formed over the core by surrounding the core by a pair of preformed hemispherical cups followed by heat compression molding or by injection molding the cover composition over the core.

Like conventional golf balls, the three-piece solid golf ball of the invention is formed with a multiplicity of dimples in the cover surface. The golf ball of the invention is formed with dimples such that, provided that the golf ball is a sphere defining a phantom spherical surface, the proportion of the surface area of the phantom spherical surface delimited by the edge of respective dimples relative to the overall surface area of the phantom spherical surface, that is the percent occupation of the ball surface by the dimples is at least 62%, preferably 63 to 85%. With a dimple occupation of less than 62%, the above-mentioned flight performance, especially an increased flight distance is not expectable. The total number of dimples is preferably 360 to 450, more preferably 370 to 440. There may be two or more types of dimples which are different in diameter and/or depth. It is preferred that the dimples have a diameter of 2.2 to 4.5 mm and a depth of 0.12 to 0.23 mm. The arrangement of dimples may be selected from regular octahedral, dodecahedral, and icosahedral arrangements as in conventional golf balls while the pattern formed by thus arranged dimples may be any of square, hexagon, pentagon, and triangle patterns.

Moreover, the dimples are preferably formed such that V_0 is 0.39 to 0.6, especially 0.41 to 0.58 wherein V_0 is the volume of the dimple space below a plane circumscribed by the dimple edge divided by the volume of a cylinder whose bottom is the plane and whose height is the maximum depth of the dimple from the bottom.

Now the shape of dimples is described in further detail. In the event that the planar shape of a dimple is circular, as shown in FIG. **2**, a phantom sphere **6** having the ball diameter and another phantom sphere **7** having a diameter smaller by 0.16 mm than the ball diameter are drawn in conjunction with a dimple **5**. The circumference of the other sphere **7** intersects with the dimple **5** at a point **8**. A tangent **9** at intersection **8** intersects with the phantom sphere **6** at a point **10** while a series of intersections **6** define a dimple edge **11**. The dimple edge **11** is so defined for the reason that otherwise, the exact position of the dimple edge cannot be determined because the actual edge of the dimple **5** is rounded. The dimple edge **11** circumscribes a plane **12** (having a diameter Dm). Then as shown in FIGS. **3** and **4**, the dimple space **13** located below the plane **12** has a volume Vp. A cylinder **14** whose bottom is the plane **12** and whose height is the maximum depth Dp of the dimple from the bottom or circular plane **12** has a volume Vq. The ratio V_0 of the dimple space volume Vp to the cylinder volume Vq is calculated.

$$Vp = \int_0^{\frac{Dm}{2}} 2\pi xy\,dx$$

$$Vq = \frac{\pi Dm^2 Dp}{4}$$

$$V_0 = \frac{Vp}{Vq}$$

In the event that the planar shape of a dimple is not circular, the maximum diameter or length of a dimple is determined, the plane projected shape of the dimple is assumed to be a circle having a diameter equal to this maximum diameter or length, and V_0 is calculated as above based on this assumption.

Furthermore, provided that the number of types of dimples formed in the ball surface is n wherein $n \geqq 2$, preferably n=2 to 6, more preferably n=3 to 5, and the respective types of dimples have a diameter Dmk, a maximum depth Dpk, and a number Nk wherein k=1, 2, 3, . . . , n, the golf ball of the invention prefers that an index Dst of overall dimple surface area given by the following equation (1) is at least 4, more preferably 4 to 8.

$$Dst = \frac{n\sum_{k=1}^{n}[(Dmk^2 + Dpk^2)\times V_0 k \times Nk]}{4R^2} \quad (1)$$

Note that R is a ball radius, V_0 is as defined above, and Nk is the number of dimples k. The index Dst of overall dimple surface area is useful in optimizing various dimple parameters so as to allow the golf ball of the invention having the above-mentioned solid core and cover to travel a further distance. When the index Dst of overall dimple surface area is equal to or greater than 4, the aerodynamics (flying distance and flight-in-wind) of the golf ball are further enhanced.

While the three-piece solid golf ball of the invention is constructed as mentioned above, other ball parameters including weight and diameter are properly determined in accordance with the Rules of Golf.

The three-piece solid golf ball of the invention will travel an increased flight distance on full shots with a driver and be easy to control on approach shots with No. 5 iron or sand wedge.

EXAMPLE

Examples of the present invention are given below together with Comparative Examples by way of illustration and not by way of limitation. The amounts of components in the core, intermediate layer, and cover as reported in Tables 1 and 2 are all parts by weight.

Examples 1–5 and Comparative Examples 1–4

Solid cores, Nos. 1 to 6, were prepared by kneading components in the formulation shown in Table 1 to form a rubber composition and molding and vulcanizing it in a mold under conditions as shown in Table 1. The cores were measured for JIS-C hardness and diameter, with the results shown in Tables 3 and 4. The JIS-C hardness of the core was measured by cutting the core into halves, and measuring the hardness at the center (center hardness) and the hardness at core surface or spherical surface (surface hardness). The result is an average of five measurements.

TABLE 1

Core No.	1	2	3	4	5	6
Formulation						
Cis-1,4-poly-butadiene rubber	100	100	100	100	100	100
Zinc acrylate	24	24	25	29	15	34
Zinc oxide	29	26	34	27	33	25
Dicumyl peroxide *1	1	1	1	1	1	0
	0.3	0.3	0.3	0.3	0.3	1
Vulcanizing conditions						
Temperature, °C.	160	160	160	160	160	155
Time, min.	20	20	20	20	20	15
Core hardness*2, mm	3.7	3.7	3.5	3	5.7	2.2

*1 1,1-bis(t-butylperoxy)-3,3,5-trimethylcyclohexane (trade name Perhexa 3M-40 manufactured by Nippon Oil and Fats K.K.)
*2 distortion under a load of 100 kg

Next, compositions for the intermediate layer and cover were milled as shown in Table 2 and injection molded over the solid core and the intermediate layer, respectively, obtaining three-piece solid golf balls as shown in Table 4. At the same time as injection molding, two or three types of dimples were indented in the cover surface as shown in Table 3. Whenever the intermediate layer and cover were molded, the intermediate layer and cover were measured for JIS-C hardness, specific gravity and gage. The results are also shown in Table 4.

TABLE 2

Intermediate layer and cover formulations (pbw)	A	B	C	D	E
Himilan 1557*3	50	—	50	—	—
Himilan 1601*3	—	—	50	—	—
Himilan 1605*3	50	50	—	—	—
Himilan 1855*3	—	—	—	50	50
Himilan 1856*3	—	—	—	—	50
Himilan 1706*3	—	50	—	—	—
Surlyn 8120*4	—	—	—	50	—

*3 ionomer resin manufactured by Mitsui-duPont Polychemical K.K.
*4 ionomer resin manufactured by E.I. duPont of USA

TABLE 3

Dimple set	Diameter (mm)	Depth (mm)	V_0	Number	Dst	Surface occupation (%)
				Dimple		
I	4.000	0.200	0.50	72	4.539	75
	3.850	0.193	0.50	200		
	3.400	0.170	0.50	120		
				total 392		
II	3.800	0.205	0.48	162	4.263	74
	3.600	0.194	0.48	86		
	3.450	0.186	0.48	162		
				total 410		
III	3.400	0.195	0.39	360	2.148	61
	2.450	0.195	0.39	140		
				total 500		

The thus obtained golf balls were evaluated for flight performance, spin, feel, spin control, and durability by the following tests.

Flight performance

Using a hitting machine manufactured by True Temper Co., the ball was actually hit with a driver (#W1) at a head speed of 45 m/s (HS45) and 35 m/sec. (HS35) to measure a spin, carry, and total distance.

Feel

Five golfers with a head speed of 45 m/sec. (HS45) and five golfers with a head speed of 35 m/sec. (HS35) actually hit the balls. The ball was rated according to the following criterion.

○:soft

Δ:ordinary

X:hard

Spin control

Three professional golfers actually hit the ball with No. 5 iron (#I5) to examine intentional hook and slice and stoppage on the green and also with a sand wedge (#SW) to examine spin on 30 and 80 yard shots (that is, stoppage on the green and ease of capture of the ball upon impact). An overall rating of the ball was derived from these spin control factors. The ball was rated "○" for easy control, "Δ" for ordinary, and "X" for difficult control.

Durability

Durability against continuous strikes and durability against cutting were evaluated in combination. The ball was rated according to the following criterion.

○:excellent

Δ:ordinary

X:inferior

TABLE 4

	Examples					Comparative Examples			
	1	2	3	4	5	1	2	3	4
Core									
Type	1	2	3	4	1	1	5	6	4
Center hardness A (JIS-C)	64	64	65	68	64	64	52	80	68
Surface hardness B (JIS-C)	75	75	77	82	75	75	62	90	82
B – A	11	11	12	14	11	11	10	10	14
Diameter (mm)	36.5	37.9	35.1	37.9	36.5	36.5	36.5	36.5	37.9
Intermediate layer									
Type	A	A	B	B	C	A	D	B	A
Hardness C (JIS-C)	86	86	93	93	83	86	75	93	86
C – B	11	11	16	11	8	11	13	3	4
Specific gravity	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Gage (mm)	1.6	1.2	1.8	1.2	1.6	1.6	1.6	1.6	1.8
Cover									
Type	E	E	C	F	D	E	B	A	B
Hardness D (JIS-C)	80	80	83	80	75	81	93	86	93
D – C	–6	–6	–10	–13	–8	–5	18	–7	7
Specific gravity	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Gage (mm)	1.5	1.5	2.0	1.5	1.5	1.5	1.5	3.5	2.0
Intermediate layer/cover combined gage (mm)	3.1	2.7	3.8	2.7	3.1	3.1	3.1	5.1	3.8
Dimple set	I	I	II	II	II	III	I	I	I
Ball outer diameter (mm) #W1/HS45	42.7	42.7	42.7	42.7	42.7	42.7	42.7	42.7	42.7
Spin (rpm)	2800	2750	2900	2700	2950	2800	2650	2700	2680
Carry (m)	209.0	210.0	210.0	209.5	210.5	207.0	209.0	207.5	208.5
Total (m)	223.0	224.5	223.5	222.0	224.0	218.0	221.0	217.0	218.0
Feel	○	○	○	○	○	○	Δ	X	X
#W1/HS35									
Spin (rpm)	4600	4400	4650	4700	4750	4600	4600	4680	4630
Carry (m)	142.0	144.0	142.5	144.0	143.0	138.0	142.5	139.0	140.0
Total (m)	150.0	153.0	150.0	152.5	152.0	145.0	149.5	145.5	148.0
Feel	○	○	○	○	Δ	○	Δ	X	X
Spin control	○	○	○	○	○	○	X	Δ	X
Durability	○	○	○	○	○	○	X	Δ	Δ

Note:
A hardness difference is represented by (B – A), (C – B), and (D – C). (B – A) is equal to the core surface hardness minus the core center hardness; (C – B) is equal to the intermediate layer hardness minus the core surface hardness; and (D – C) is equal to the cover hardness minus the intermediate layer hardness.

As is evident from Table 4, the ball of Comparative Example 1 which is identical with the ball of Example 1 except for the dimple set is unsatisfactory in flight distance because the dimple surface occupation is as low as 61%. The ball of Comparative Example 2 is inferior in hitting feel, spin control, and durability since the cover is harder than the intermediate layer. The ball of Comparative Example 3 is unsatisfactory in flight distance and hitting feel because the core surface hardness and core center hardness are too high and the hardness difference between the intermediate layer and the core surface is too small. The ball of Comparative Example 4 is inferior in flight distance, hitting feel, and spin control since the cover is harder than the intermediate layer and the intermediate layer is insufficiently harder than the core.

In contrast, the golf balls of Examples 1 to 5 within the scope of the invention receive an appropriate spin rate upon full shots with a driver to travel a longer flight distance, are easy to spin control upon approach shots, and are excellent in both hitting feel and durability.

Japanese Patent Application No. 82121/1996 is incorporated herein by reference.

Although some preferred embodiments have been described, many modifications and variations may be made thereto in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described.

We claim:

1. A three-piece solid golf ball of the three-layer structure comprising a solid core, an intermediate layer, and a cover, having a plurality of dimples in the ball surface wherein

the solid core, intermediate layer, and cover each have a hardness as measured by a JIS-C scale hardness meter wherein the core center hardness is up to 75 degrees, the core surface hardness is up to 85 degrees, the core surface hardness is higher than the core center hardness by 8 to 20 degrees, the intermediate layer hardness is higher than the core surface hardness by at least 5 degrees, and the cover hardness is lower than the intermediate layer hardness by at least 5 degrees, and

the dimples occupy at least 62% of the ball surface.

2. The three-piece solid golf ball of claim 1 wherein said intermediate layer has a gage of 0.2 to 3 mm and a specific gravity of 0.9 to less than 1.2.

3. The three-piece solid golf ball of claim 1 wherein said cover is based on a thermoplastic resin and has a hardness of up to 90 degrees as measured by the JIS-C scale hardness meter.

4. The three-piece solid golf ball of claim 1 wherein said cover has a gage of 0.2 to 3 mm and a specific gravity of 0.9 to less than 1.2.

5. The three-piece solid golf ball of claim 1 wherein said solid core is formed of a cis-1,4-polybutadiene base elastomer and has a diameter of 34 to 41 mm.

6. The three-piece solid golf ball of claim 1 wherein the dimples in the ball surface total in number to 360 to 450 and include at least two types of dimples having different diameters, and an index (Dst) of overall dimple surface area given by the following expression is at least 4,

$$Dst = \frac{n \sum_{k-1}^{n} [(Dmk^2 + Dpk^2) \times V_0 k \times Nk]}{4R^2}$$

wherein R is a ball radius, n is the number of dimple types ($n \geqq 2$), Dmk is a diameter of dimples k, Dpk is a depth of dimples k, Nk is the number of dimples k wherein k=1, 2, 3, . . . n, and V_0 is the volume of the dimple space below a plane circumscribed by the dimple edge divided by the volume of a cylinder whose bottom is the plane and whose height is the maximum depth of the dimple from the bottom.

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UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 5,782,707
DATED : July 21, 1998
INVENTOR(S) : Hisashi Yamagishi et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Please add claims 7-17 as follows:

7. The three-piece solid golf ball of claim 6 wherein Dmk is in the range of 2.2 to 4.5 and Dpk is in the range of 0.12 to 0.23 mm.

8. The three-piece solid golf ball of claim 6 wherein V_0 is in the range of 0.39 to 0.6.

9. The three-piece solid golf ball of claim 1 wherein said core center hardness is in the range of 60 to 73 as measured on JIS-C.

10. The three-piece solid golf ball of claim 1 wherein said core has a surface hardness in the range of 70 to 83 degrees on JIS-C.

11. The three-piece solid golf ball of claim 1 wherein said core surface hardness is higher than the center hardness by 10 to 18 degrees.

12. The three-piece solid golf ball of claim 1 wherein said solid core has a distortion in the range of 2.5 to 4.5 mm under an applied load of 100 kg.

13. The three-piece solid golf ball of claim 1 wherein said intermediate layer has a hardness in the range of 75 to 100 degrees measured on JIS-C.

14 The three-piece solid golf ball of claim 1 wherein said intermediate layer has a hardness higher than the core surface hardness by t to 20 degrees.

15. The three-piece solid golf ball of claim 1 wherein said cover has a hardness in the range of 70 to 90 degrees measured on JIS-C.

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 5,782,707
DATED : July 21, 1998
INVENTOR(S) : Hisashi Yamagishi et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

16. The three-piece solid golf ball of claim 1 wherein the gage of the intermediate layer and the cover combined is in the range of 2 to 4.5 mm.

17. The three-piece solid golf ball of claim 1 wherein said dimples occupy 63 to 85% of the ball surface

Signed and Sealed this

Sixth Day of November, 2001

Attest:

Nicholas P. Godici

Attesting Officer

NICHOLAS P. GODICI
Acting Director of the United States Patent and Trademark Office

EXHIBIT 6

REDACTED

EXHIBIT 7

REDACTED

EXHIBIT 8

REDACTED

EXHIBIT 9

REDACTED